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VORCOR - A Computer Program for Calculating Characteristics of Wings With Edge Vortex Separation by Using a Vortex Filament and Core Model

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INTRODUCTION

This report is a supplement to reference 1 and describes the usage of a computer program implementing an improved vortex-core method described in reference 1. The method is applicable to cambered wings, straked wings or wings with leading-edge vortex flaps at subsonic speeds. The prediction of lifting pressure distribution and the computer time based on the diffused vortex-filament method in reference 2 have been improved by using a pair of concentrated vortex cores above the wing surface.

In the following, the program capabilities, input format and output format are described. Then, input data of two sample test cases (a delta wing with conical camber and a double delta wing) and the corresponding output, as well as the program listing are given.

PROGRAM CAPABILITIES

This program has the following main features:

(1) Arbitrary camber shapes may be defined at ten or less spanwise stations. Option for exactly defining leading-edge flap geometry is also provided.

(2) Eight spanwise strips are usually used for simple wings (such as delta wings) and nine spanwise strips for double delta wings.

(3) The side-edge vortex system is incorporated.

(4) In the core model method, the starting solution for wings at angles of attack less than 20 degrees is taken to be the initial shape at 20-degrees angle of attack.

INPUT DATA FORMAT

<u>Group 1</u> Format (16A5)

TTL(I) Any title identifying the case to be run. END in first three columns terminates the job.

N83-70599 #

Group 2 Format (6I5)

NCW Number of chordwise vortex elements on the wing surface. Limited to nine.

NBRR Number of constant x-locations where the spanwise lifting pressures are to be interpolated. Limited to twenty-five.

NCONTS = 0, if initial locations of free elements are calculated in the program.

= 1, if initial locations of free elements are to be read from data cards. For wings at angles of attack less than 20 degrees, the initial shape at 20 degrees is to be used.

MITER Maximum number of iterations to be performed (usually between 7 and 9).

IPUNCH = 0, if coordinates of free elements after the last iteration are not to be punched out.

= 1, if coordinates of free elements after the last iteration are to be punched out.

KU1 = 2, two iterations to be performed in the vortex filament model.

Note: If KU1 is greater than MITER, the vortex filament model is to be run in the entire iteration process.

Group 3 Format (6I5)

NC Number of spanwise sections on the right wing (bounded by points of discontinuities in geometry, such as change in sweep). Limited to two. (See sketch 1).

M1(I) Number of spanwise strips in each spanwise section plus one. Limited to twenty.

ICAM = 0, for non-cambered airfoils.

= 1, if cambered ordinates are to be read in.

= 2, if camber slopes are defined analytically in subroutine ZCDX.

= 3, if there are flat leading-edge flaps attached to a non-cambered wing.

IST Number of y-stations at which camber ordinates are read in. Limited to ten. If ICAM=3, IST is the number of leading-edge flap segments; for example, IST would be 1 for a simple flat leading-edge flap. If ICAM=1, at least two y stations are needed, one being at the root and the other being at the tip.

ITERS = 0, for wings at angles of attack greater than 20 degrees and NCONTS=0.

= 3, for wings at angles of attack less than 20 degrees and NCONTS=1.

Group 4 Format (2I5)

ISPAN = 0, if the leading-edge free elements start from the center line of geometry.

= 1, if the leading-edge free elements do not start from the center line of geometry.

Use 0 always in the present version of the program.

ITRAKE = 1, for one vortex-core system on the right wing.

= 2, for two fortex-core system on the right wing.

Group 5 Format (8F10.5)

ALPHA Angle of attack (in degrees)

AMACH Mach number. Limited to subsonic flow.

DELTA Length of a segment of leading-edge free vortex elements (may be taken as 0.15 c_R, where c_R is the root chord).

DL Length of a segment of wake elements (may be taken as 0.15 c_R).

XEND x-coordinate beyond which free vortex elements from the leading edge and the wake are represented by a single element going to infinity.

CBAR Reference chord.

AREA Total reference wing area.

CLS Reference lift coefficient.

Note: The reference lift coefficient CLS for use in adjusting the core move-

ment is based on the suction analogy as implemented by Lan (reference 3).

Group 6 Format (9I5)

NFSH(I) Number of segments along each vortex element on the leading-edge free vortex sheet.

= 5, if ITERS = 0.

= 6, if ITERS = 3.

Omit Groups 7, 8 and 9 if ICAM ≠ 1. Repeat Group 7, 8, 9 IST times.

Group 7 Format (4F10.6)

YT(I) y-station at which camber ordinates are read in.

XNUM Number of camber ordinates to be read in. Limited to 21.

CURV(I) = 0, if camber is to be formed by connecting straight segments, with first segment being regarded as flat leading-edge flap.

= 1, if cubic spline interpolation is used.

= 2, if cubic spline interpolation is used, with first segment being flat leading-edge flap.

CHND(I) Chord length at YT(I) station.

Group 8 Format (8F10.6)

XT(I,J) x/c values at which camber ordinates are read in for YT(I) station.

Group 9 Format (8F10.6)

CA(J) z/c values of camber ordinates at the corresponding XT(I,J) locations.

Omit Groups 10, 11 and 12 if ICAM ≠ 3. Repeat IST times.

Group 10 Format (2F10.6)

YLEF(I,1) Extreme inboard y-coordinate of I-th flat leading-edge flap segment.

YLEF(I,2) Extreme outboard y-coordinate of I-th flat leading-edge flap segment.

Group 11 Format (6F10.6)

XLF(I,1), YLF(I,1), Z1 } First corner point coordinates of I-th flat leading-edge flap segment. (see sketch 2)

XLF(I,2), YLF(I,2), Z2 — Second corner point coordinates of I-th flat leading-edge flap segment.

Group 12 Format (6F10.6)

XLF(I,3), YLF(I,3), Z3 — Third corner point coordinates of I-th flat leading-edge flap segment.

XLF(I,4), YLF(I,4), Z4 — Fourth corner point coordinates of I-th flat leading-edge flap segment.

Note: The flat flap must be inside the boundary of planform described in Group 13.

Group 13 Format (6F10.5)

Corner-point coordinates of a spanwise section (See sketch 3).

XXL(1) Leading-edge x-coordinate of the inboard chord.

XXT(1) Trailing-edge x-coordinate of the inboard chord.

YL(1) y-coordinate of the inboard chord.

XXL(2) Leading-edge x-coordinate of the outboard chord.

XXT(2) Trailing-edge x-coordinate of the outboard chord.

YL(2) y-coordinate of the outboard chord.

Omit Groups 14, 15, 16, 17, 18 and 19 if NCONTS = 0.

Group 14 Format (10I2)

NELM(I) Number of vortex segments along each vortex element in the leading-edge vortex system.

Group 15 Format (8F10.4)

XE(J), YE(J), ZE(J) — x-, y- and z-coordinates of endpoints (away from the leading edge) of the leading-edge vortex segments on and above the wing surface.

Group 16 Format (10I2)

NNELM(I) Number of vortex segments along each vortex element in the wake

system behind the trailing edge.

Group 17 Format (8F10.4)

XXE(J) YYE(J) ZZE(J)	x-, y- and z-coordinates of downstream endpoints of wake vortex segments behind the trailing edge.

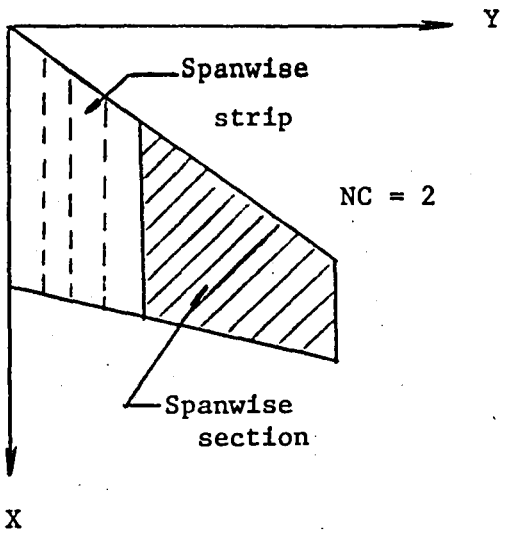
Omit Groups 18 and 19 if the wing planform has a zero tip chord.

Group 18 Format (10I2)

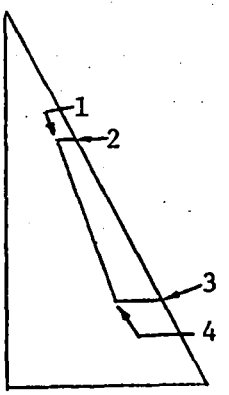
NTLM(I) Number of vortex segments along each vortex element in the side-edge vortex system.

Group 19 Format (8F10.4)

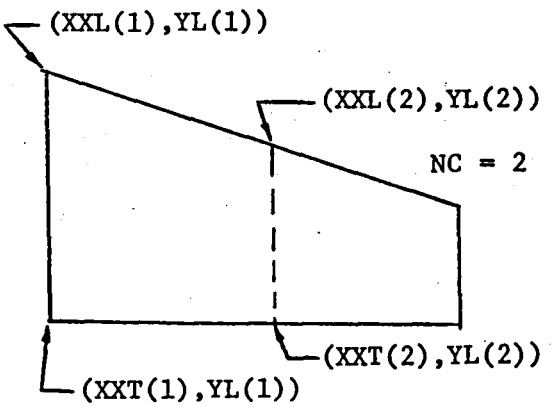
XTIP(I,J) YTIP(I,J) ZTIP(I,J)	x-, y- and z-coordinates of endpoints (away from the side edge) of vortex segments on side-edge vortex elements.



Sketch 1.



Sketch 2.



Sketch 3.

OUTPUT FORMAT

(1) First, all input data will be printed.

(2) Camber slopes at wing bound elements (with respect to fine grids).

DZDXV DZDYV	At bound elements

(3) Camber slopes at wing control points and bound elements (with respect to coarse grids).

DZDX DZDY	At control points
DZDYV	At bound elements.

(4) Camber slopes at leading-edge control points of each spanwise strip.

DZDX DZDY	At leading-edge control points.

(5) Leading-edge vortex element system:

XE YE ZE	x-, y- and z-coordinates of endpoints (away from the leading edge) of vortex segments in the leading-edge vortex element system on and above the wing.

(6) Wake element system:

XXE YYE ZZE	x-, y- and z-coordinates of each vortex segment in the wake system behind the trailing edge.

(7) Plots of leading-edge free elements above the wing and wake elements behind the trailing edge, on X-Y, X-Z and Y-Z planes respectively.

(8) Wing vortex-density distribution:

X/C	Nondimensional x-coordinate, referred to local chord (with respect to coarse grids).
2Y/B	nondimensional y-station, referred to wing semi-span.
GAMAY	Bound vortex density on the wing (γ_y) at the given (X/C, 2Y/B).

(9) Leading-edge vortex strengths:

2Y/B Nondimensional y-station, referred to wing semi-span.

CAPGAMA Strength of the leading-edge free element (Γ) at the given 2Y/B.

(10) Wing surface lifting-pressure distribution:

X/C Nondimensional x-coordinate, referred to local chord (with respect to fine grids).

2Y/B Nondimensional y-station, referred to wing semi-span.

DELTA-CP The total ΔC_p at the given (X/C, 2Y/B)

(11) Sectional characteristics:

I Spanwise station number (numbered from root to tip).

CLI Sectional lift coefficient.

CMI Sectional pitching moment coefficient about the y-axis.

CDI Sectional induced drag coefficient.

CTI Sectional leading-edge thrust coefficient.

(12) The next group of output variables is the overall aerodynamic characteristics.

(13) Spanwise lifting pressures at constant x-locations.

Y y-coordinate.

2Y/B(LOCAL) Nondimensional y-station, referred to wing local semi-span.

DELTA-CP Total ΔC_p at the given (x,y).

(14) Summary sheet:

ITERATION Iteration number.

CL The total lift coefficient.

CM The total pitching moment coefficient about y-axis.

CD The total induced drag coefficient.

CT The total leading-edge thrust coefficient.

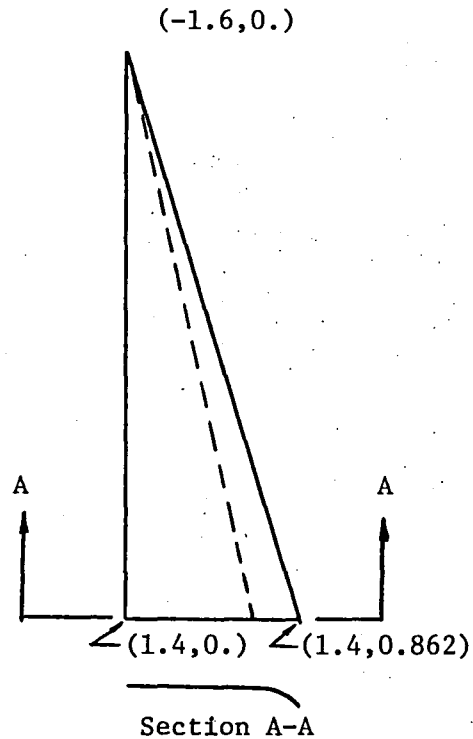
GMSUM Sum of strengths of leading-edge free vortex elements, except the one at the center line.

SFAC Sum of the magnitude of total force acting on the core and free sheet.

(15) The last portion of the output consists of the converged positions and orientations of free sheet vortex elements and the concentrated core, and aerodynamic characteristics corresponding to the solution in which "SFAC" of (14) reaches a minimum value in the iteration cycle.

1. Input Data of the First Sample Case

```
                                    C O L U M N   N U M B E R
                  1111111111222222222233333333334444444444555555555566666666667777777777778
          12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD NUMBER
     1                                CONICAL CAMBER WING AT ALPHA 30.7 DEGREES
     2          6     3     0     8     0     2
     3          1     9     2     1     0
     4          0     1
     5     30.7       0.          0.25       0.75       5.5        2.0        2.586      1.297
     6          5     5     5     5     5     5     5     5
     7     -0.4       0.41        1.205
     8     0.         0.          0.         0.         0.         0.         0.         0.
     9     -1.6       1.4         0.         1.4        1.4        0.862
    10     -1.6       1.4         0.         1.4        1.4        0.862
    11     END
```



Section A-A

Output of the First Sample Case

```
INPUT DATA CARDS
                    CONICAL CAMBER WING AT ALPHA 30.7 DEGREES
   6    3    0    8    0    2
   1    9    2    1    0
   0    1
 30.70000   0.00000    .25000    .75000   5.50000   2.00000   2.58600   1.29700
   5    5    5    5    5    5    5    5
  -.40000    .41000   1.20500
  0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
 SPANWISE SECTION OF NUMBER     1
 -1.60000   1.40000   0.00000   1.40000   1.40000    .86200

 CAMBER SLOPE AT FINE GRID BOUND ELEMENT

   DZDXV     DZDYV
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
   .12741   -.51416
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
   .23158   -.89945
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
   .29498  -1.12608
   .06370   -.26520
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
   .33447  -1.26531
   .15297   -.61032
   .02880   -.12231
  0.00000   0.00000
  0.00000   0.00000
```

0.00000	0.00000
0.00000	0.00000
.35909	-1.35156
.23490	-.91143
.12778	-.51555
.05378	-.22515
.00206	-.00891
0.00000	0.00000
0.00000	0.00000
.37309	-1.40356
.30968	-1.17452
.23187	-.90050
.17034	-.67546
.12696	-.51243
.09950	-.40671
.08616	-.35450
.38199	-1.42144
.36342	-1.36737
.33459	-1.26576
.30408	-1.15929
.27827	-1.06675
.26017	-1.00218
.25094	-.96914

SPANWISE SECTION OF NUMBER 1

-1.60000	1.40000	0.00000	1.40000	1.40000	.86200

CAMBER SLOPE AT COARSE GRID BOUND ELEMENT

DZDX	DZDY	DZDYV
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	-.36323
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
.02761	-.11734	-.78317
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
.12675	-.51161	-1.04319
0.00000	0.00000	-.09657

0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
.20825	-.81484	-1.21255
.04627	-.19450	-.47312
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
.27813	-1.06627	-1.32243
.14303	-.57334	-.80139
.05378	-.22515	-.38375
0.00000	0.00000	-.09129
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
.33423	-1.26448	-1.39086
.24389	-.94381	-1.10431
.17034	-.67546	-.79915
.12134	-.48097	-.57308
.09354	-.38346	-.42802
.08450	-.34799	-.35685
.37141	-1.39455	-1.42832
.33976	-1.28387	-1.34416
.30408	-1.15829	-1.22015
.27467	-1.05394	-1.10205
.25608	-.98755	-1.01549
.24978	-.96498	-.97064

CAMBER SLOPE AT THE LEADING EDGE CONTROL POINTS

DZDX	DZDY
.38452	-1.44024
.38452	-1.44024
.38452	-1.44024
.38452	-1.44024
.38452	-1.44024
.38452	-1.44024
.38452	-1.44024
.38452	-1.44024

END OF INPUT DATA

CONICAL CAMBER WING AT ALPHA 30.7 DEGREES

ALPHA(DEG.)=30.700 MACH NUMBER= 0.000 ITERATION NUMBER= 0

LEADING EDGE ELEMENTS

****

**** 1****

1.4000	-1.3639	-1.5624	-1.6000	-1.7500	-1.4500	-1.2350
.0577	.0577	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	.1781	.3058

**** 2****

1.4000	-1.0333	-1.3639	-1.3990	-1.5390	-1.2591	-1.0441	-.7941	-.5441	-.2941	-.0441	.2059	.4559	.7059
.9559	1.2059	1.4559	1.7059	1.9559	2.2059	2.4559	2.7059	2.9559	3.2059	3.4559	3.7059	3.9559	4.2059
4.4559	4.7059	4.9559	5.2059	5.4559	5.7059								
.1540	.1540	.0577	.0577	.0577	.0577	.0577	.0577	.0577	.0577	.0577	.0577	.0577	.0577
.0577	.0577	.0577	.0577	.0577	.0577	.0577	.0577	.0577	.0577	.0577	.0577	.0577	.0577
.0577	.0577	.0577	.0577	.0577	.0577								
0.0000	0.0000	0.0000	0.0000	0.0000	.1781	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058
.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058
.3058	.3058	.3058	.3058	.3058	.3058								

**** 3****

1.4000	-.5878	-1.0333	-1.0642	-1.1874	-.9410	-.7260	-.4760	-.2260	.0240	.2740	.5240	.7740	1.0240
1.2740	1.5240	1.7740	2.0240	2.2740	2.5240	2.7740	3.0240	3.2740	3.5240	3.7740	4.0240	4.2740	4.5240
4.7740	5.0240	5.2740	5.5240										
.2836	.2836	.1540	.1540	.1540	.1540	.1540	.1540	.1540	.1540	.1540	.1540	.1540	.1540
.1540	.1540	.1540	.1540	.1540	.1540	.1540	.1540	.1540	.1540	.1540	.1540	.1540	.1540
.1540	.1540	.1540	.1540										
0.0000	0.0000	0.0000	0.0000	0.0000	.1781	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058
.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058
.3058	.3058	.3058	.3058										

**** 4****

1.4000	-.0812	-.5878	-.6130	-.7137	-.5124	-.2974	-.0474	.2026	.4526	.7026	.9526	1.2026	1.4526
1.7026	1.9526	2.2026	2.4526	2.7026	2.9526	3.2026	3.4526	3.7026	3.9526	4.2026	4.4526	4.7026	4.9526
5.2026	5.4526	5.7026											
.4310	.4310	.2836	.2836	.2836	.2836	.2836	.2836	.2836	.2836	.2836	.2836	.2836	.2836
.2836	.2836	.2836	.2836	.2836	.2836	.2836	.2836	.2836	.2836	.2836	.2836	.2836	.2836
.2836	.2836	.2836											
0.0000	0.0000	0.0000	0.0000	0.0000	.1781	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058
.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058
.3058	.3058	.3058											

**** 5****

1.4000	.4254	-.0812	-.1000	-.1750	-.0250	.1900	.4400	.6900	.9400	1.1900	1.4400	1.6900	1.9400
2.1900	2.4400	2.6900	2.9400	3.1900	3.4400	3.6900	3.9400	4.1900	4.4400	4.6900	4.9400	5.1900	5.4400
5.6900													
.5784	.5784	.4310	.4310	.4310	.4310	.4310	.4310	.4310	.4310	.4310	.4310	.4310	.4310
.4310	.4310	.4310	.4310	.4310	.4310	.4310	.4310	.4310	.4310	.4310	.4310	.4310	.4310
.4310													
0.0000	0.0000	0.0000	0.0000	0.0000	.1781	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058

.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058
.3058													
**** 6****													
1.4000	.8709	.4254	.4130	.3637	.4624	.6773	.9273	1.1773	1.4273	1.6773	1.9273	2.1773	2.4273
2.6773	2.9273	3.1773	3.4273	3.6773	3.9273	4.1773	4.4273	4.6773	4.9273	5.1773	5.4273	5.6773	
.7080	.7080	.5784	.5784	.5784	.5784	.5784	.5784	.5784	.5784	.5784	.5784	.5784	.5784
.5784	.5784	.5784	.5784	.5784	.5784	.5784	.5784	.5784	.5784	.5784	.5784	.5784	
0.0000	0.0000	0.0000	0.0000	0.0000	.1781	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058
.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	
**** 7****													
1.4000	1.2016	.8709	.8642	.8374	.8910	1.1059	1.3559	1.6059	1.8559	2.1059	2.3559	2.6059	2.8559
3.1059	3.3559	3.6059	3.8559	4.1059	4.3559	4.6059	4.8559	5.1059	5.3559	5.6059			
.8043	.8043	.7080	.7080	.7080	.7080	.7080	.7080	.7080	.7080	.7080	.7080	.7080	.7080
.7080	.7080	.7080	.7080	.7080	.7080	.7080	.7080	.7080	.7080	.7080			
0.0000	0.0000	0.0000	0.0000	0.0000	.1781	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058
.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058			
**** 8****													
1.4000	1.3008	1.2016	1.1990	1.1890	1.2091	1.4240	1.6740	1.9240	2.1740	2.4240	2.6740	2.9240	3.1740
3.4240	3.6740	3.9240	4.1740	4.4240	4.6740	4.9240	5.1740	5.4240	5.6740				
.8620	.8331	.8043	.8043	.8043	.8043	.8043	.8043	.8043	.8043	.8043	.8043	.8043	.8043
.8043	.8043	.8043	.8043	.8043	.8043	.8043	.8043	.8043	.8043				
0.0000	0.0000	0.0000	0.0000	0.0000	.1781	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058
.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058	.3058				

WAKE ELEMENTS
****

**** 1****

1.4000	1.7000	2.0000	2.7500	3.5000	4.2500	5.0000	5.7500
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 2****

1.4000	1.7000	2.0000	2.7500	3.5000	4.2500	5.0000	5.7500
.0577	.0577	.0577	.0577	.0577	.0577	.0577	.0577
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 3****

1.4000	1.7000	2.0000	2.7500	3.5000	4.2500	5.0000	5.7500
.1540	.1540	.1540	.1540	.1540	.1540	.1540	.1540
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 4****

1.4000	1.7000	2.0000	2.7500	3.5000	4.2500	5.0000	5.7500
.2836	.2836	.2836	.2836	.2836	.2836	.2836	.2836
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 5****

1.4000	1.7000	2.0000	2.7500	3.5000	4.2500	5.0000	5.7500
.4310	.4310	.4310	.4310	.4310	.4310	.4310	.4310
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 6****

1.4000	1.7000	2.0000	2.7500	3.5000	4.2500	5.0000	5.7500
.5784	.5784	.5784	.5784	.5784	.5784	.5784	.5784
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 7****

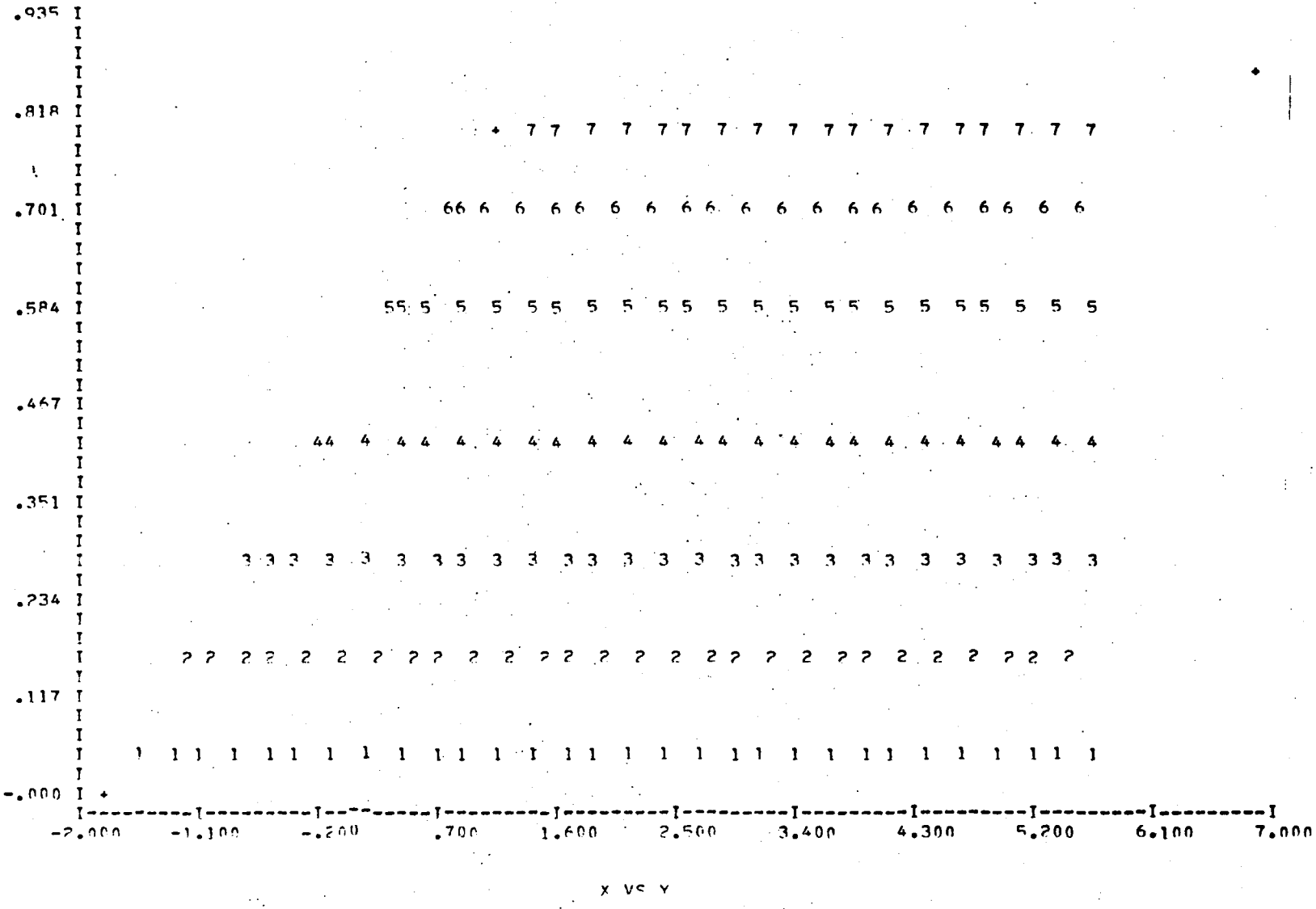
1.4000	1.7000	2.0000	2.7500	3.5000	4.2500	5.0000	5.7500
.7080	.7080	.7080	.7080	.7080	.7080	.7080	.7080
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

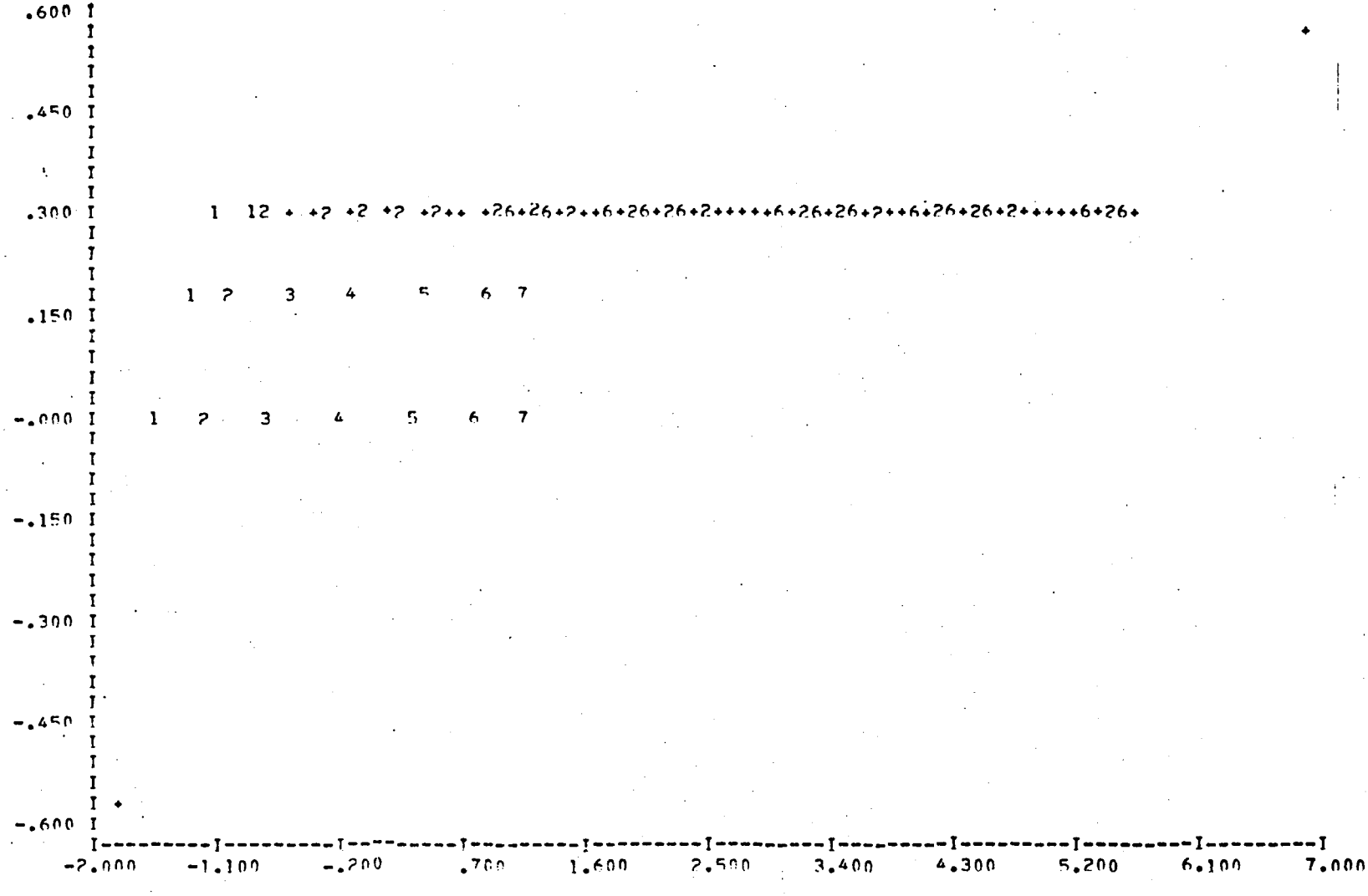
**** 8****

1.4000	1.7000	2.0000	2.7500	3.5000	4.2500	5.0000	5.7500
.8043	.8043	.8043	.8043	.8043	.8043	.8043	.8043
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 9****

1.4000	1.7000	2.0000	2.7500	3.5000	4.2500	5.0000	5.7500
.8555	.8555	.8555	.8555	.8555	.8555	.8555	.8555
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000


.935
.818
.701
.584
.467
.351
.234
.117
-.000
-2.000
-1.100
-.200
.700
1.600
2.500
3.400
4.300
5.200
6.100
7.000
X VS Y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.150
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-.150
-.300
-.450
-.600
-2.000
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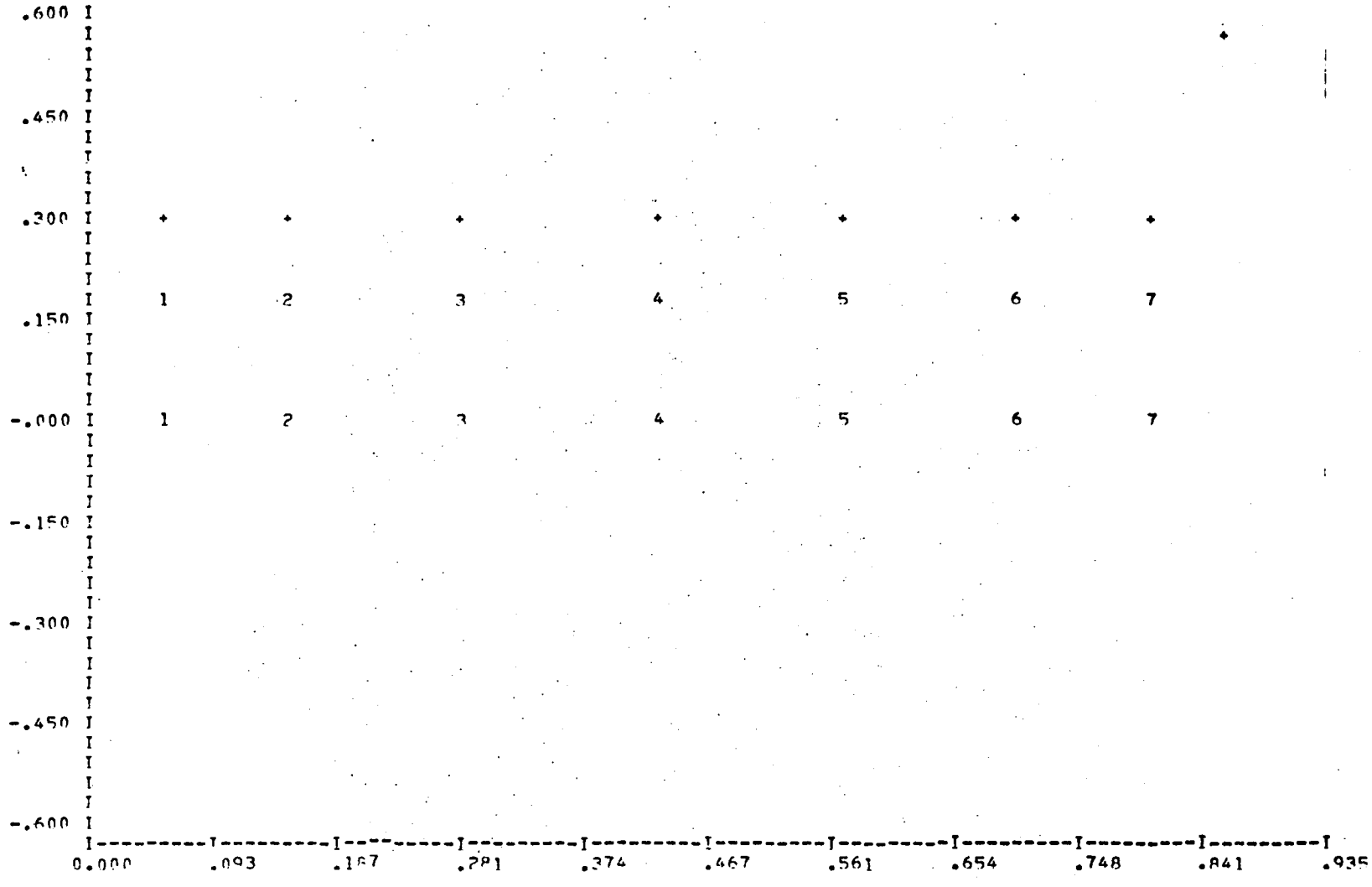
2.500
3.400
4.300
5.200
6.100
7.000

X VS Z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.300
.150
-.000
-.150
-.300
-.450
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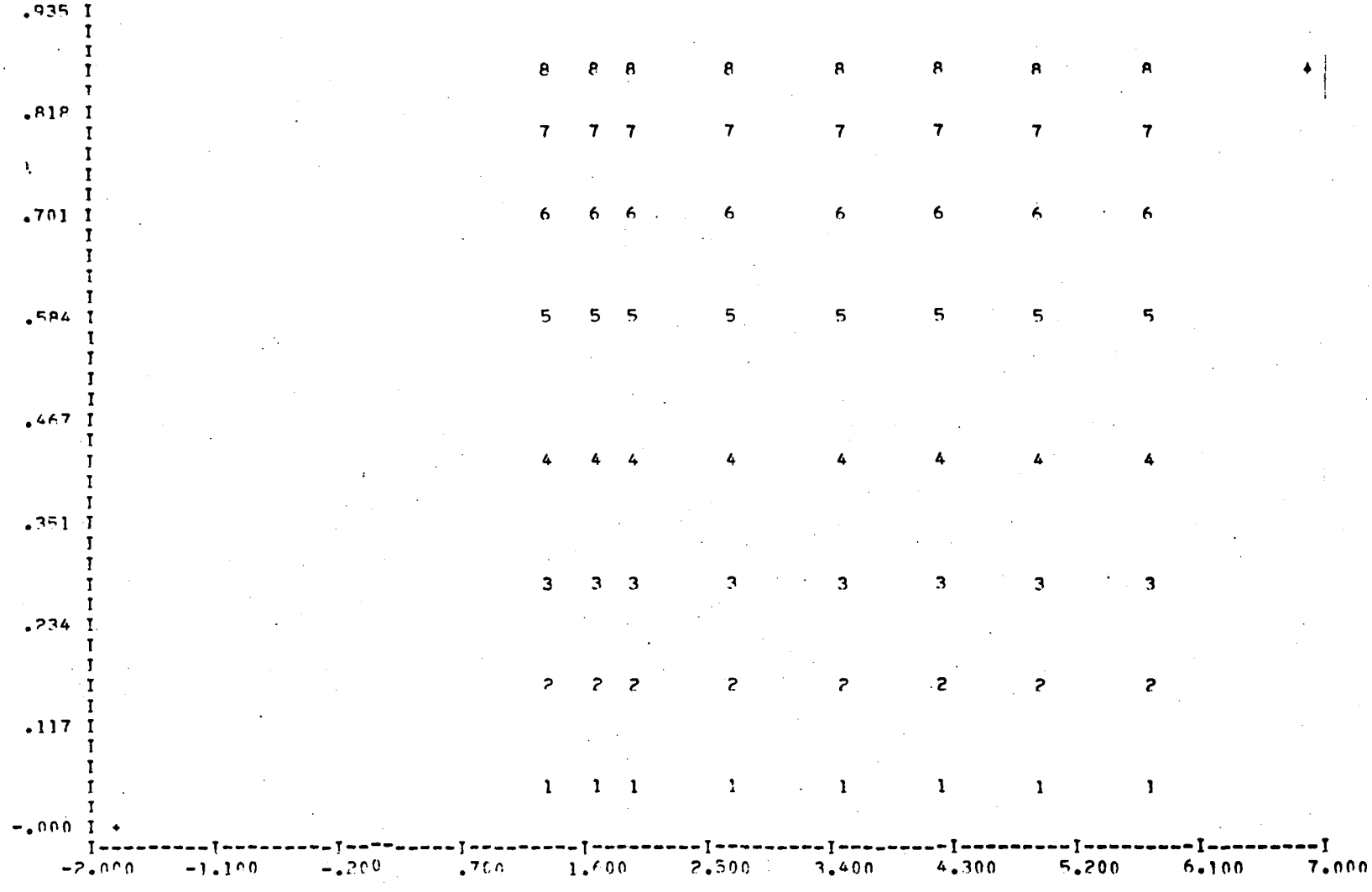
.187
.281
.374
.467
.561
.654
.748
.841
.935

Y VS Z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.818
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.467
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.117
-.000
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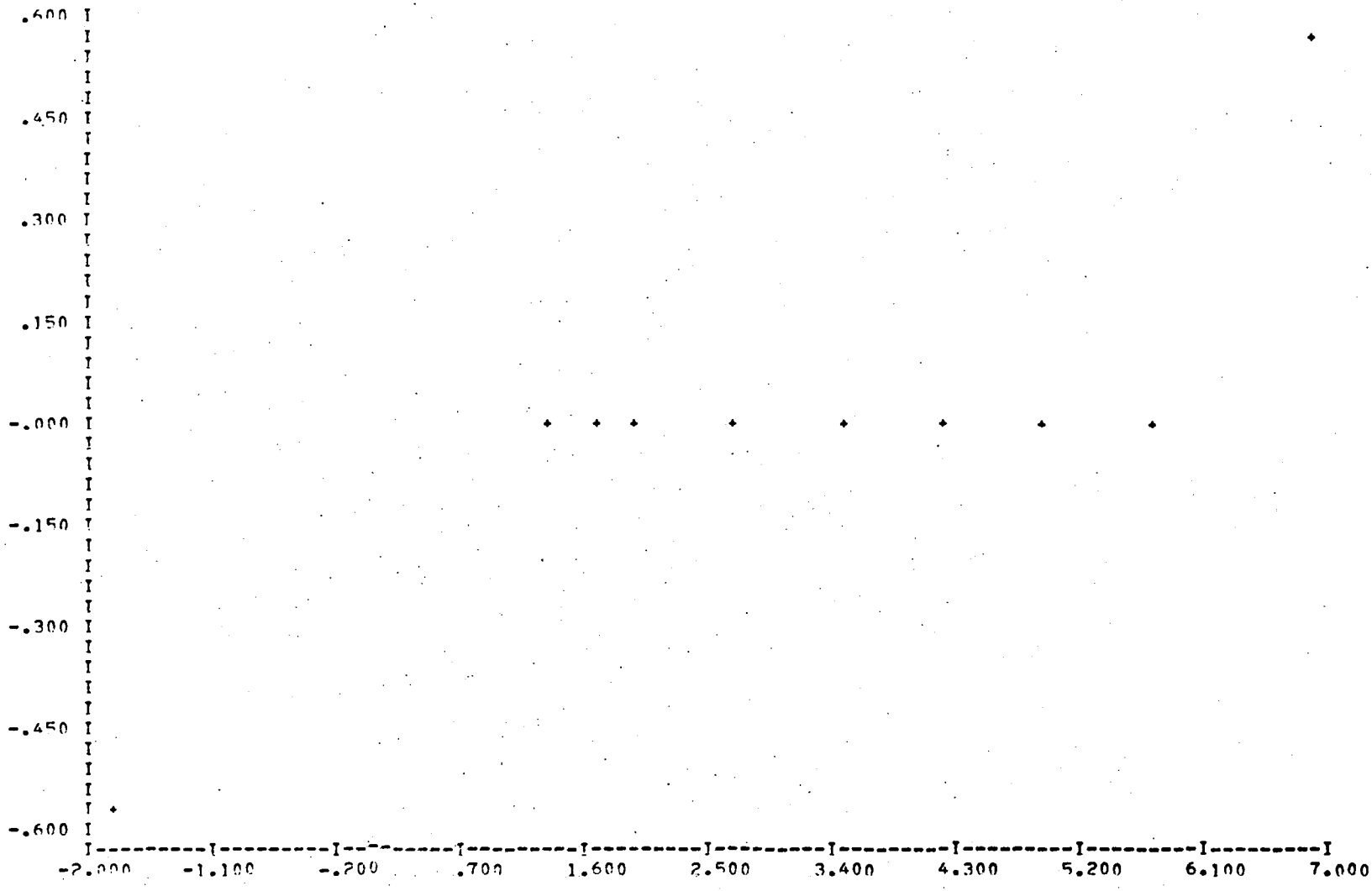
7 7 7 7 7 7 7 7
6 6 6 6 6 6 6 6
5 5 5 5 5 5 5 5
4 4 4 4 4 4 4 4
3 3 3 3 3 3 3 3
2 2 2 2 2 2 2 2
1 1 1 1 1 1 1 1
-2.000
-1.100
-.200
.700
1.600
2.500
3.400
4.300
5.200
6.100
7.000

X VS Y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.450
.300
.150
-.000
-.150
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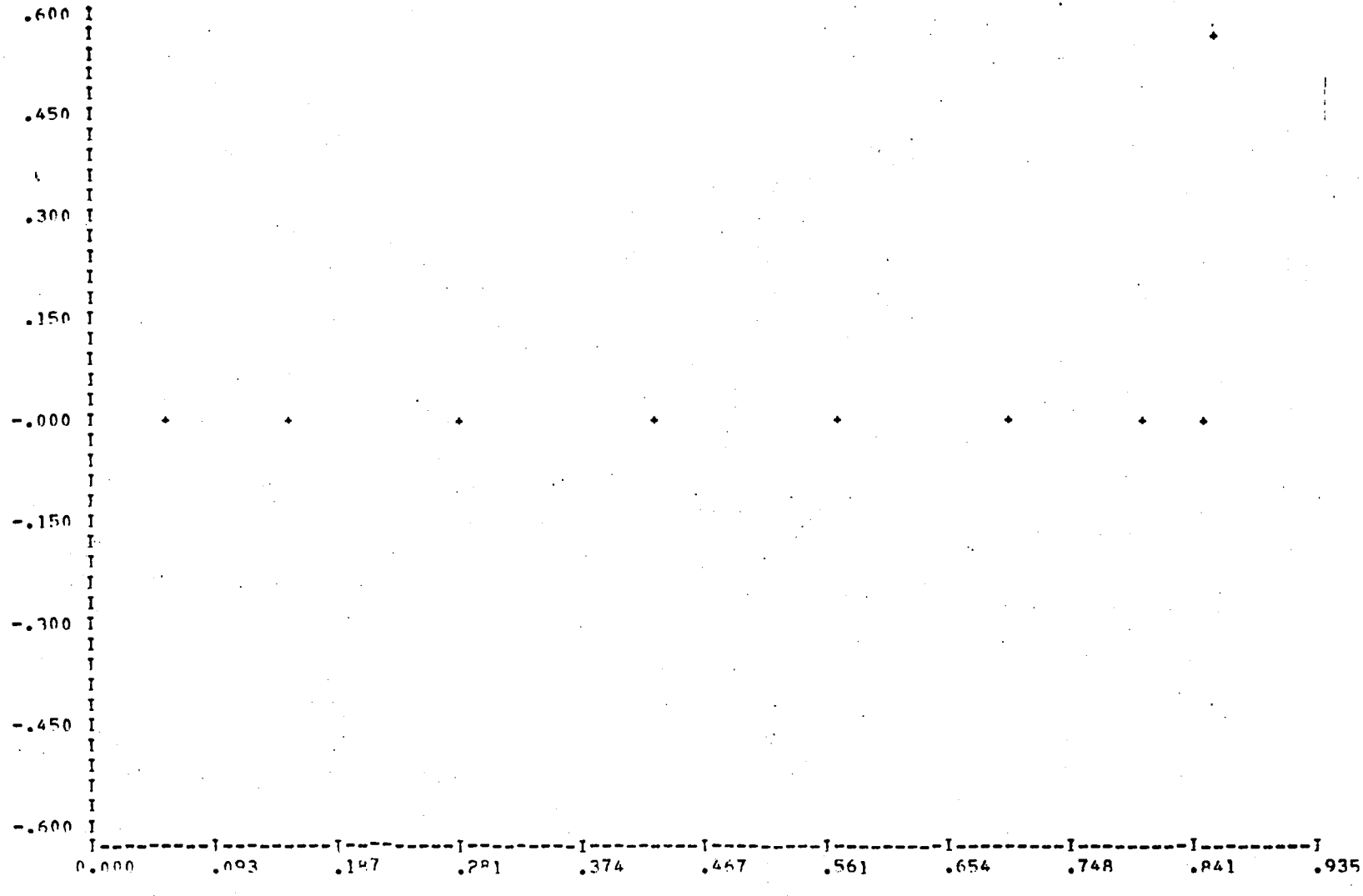
-.450
-.600
-2.000
-1.100
-.200
.700
1.600
2.500
3.400
4.300
5.200
6.100
7.000

X VS Z


.600
.450
.300
.150
-.000
-.150
-.300
-.450
-.600
0.000
.093
.187
.281
.374
.467
.561
.654
.748
.841
.935

Y VS Z

WING VORTEX STRENGTHS
****

X/C	2Y/B	GAMAY
***	****	*****
.01704	.03015	8.38200
.14645	.03015	1.01076
.37059	.03015	.57752
.62941	.03015	.33881
.85355	.03015	.18110
.98296	.03015	.05805
.01704	.11698	4.07479
.14645	.11698	.84278
.37059	.11698	.57724
.62941	.11698	.34876
.85355	.11698	.18796
.98296	.11698	.05825
.01704	.25000	3.28290
.14645	.25000	.80222
.37059	.25000	.52637
.62941	.25000	.34960
.85355	.25000	.19354
.98296	.25000	.05759
.01704	.41318	3.61828
.14645	.41318	.81333
.37059	.41318	.49334
.62941	.41318	.35042
.85355	.41318	.20046
.98296	.41318	.05876
.01704	.58682	4.41056
.14645	.58682	.79837
.37059	.58682	.52346
.62941	.58682	.37033
.85355	.58682	.21309
.98296	.58682	.06273
.01704	.75000	5.32481
.14645	.75000	.76511
.37059	.75000	.64004
.62941	.75000	.42758
.85355	.75000	.23763
.98296	.75000	.07022
.01704	.88302	6.99845
.14645	.88302	.84702
.37059	.88302	.68324
.62941	.88302	.50084
.85355	.88302	.29713
.98296	.88302	.09346

.01704	.96985	10.70191
.14645	.96985	1.14758
.37059	.96985	.77293
.62941	.96985	.61814
.85355	.96985	.41942
.98296	.96985	.15140

LEADING-EDGE VORTICES STRENGTHS
****

2Y/B	CAPGAMA
.03015	1.12870
.11698	.50160
.25000	.36111
.41318	.32146
.58682	.28186
.75000	.20867
.88302	.12942
.96985	.05129

DELTA-CP DISTRIBUTION
****

X/C	2Y/B	DELTA-CP
.01254	.03015	.93644
.10908	.03015	1.58236
.28306	.03015	1.87504
.50000	.03015	.58962
.71694	.03015	.68475
.89092	.03015	.16296
.98746	.03015	.24880
.01254	.11698	10.46179
.10908	.11698	2.57370
.28306	.11698	.84958
.50000	.11698	1.03587
.71694	.11698	.50033
.89092	.11698	.54141
.98746	.11698	.17776
.01254	.25000	5.87619
.10908	.25000	1.19066
.28306	.25000	.76001
.50000	.25000	1.26132
.71694	.25000	.75740
.89092	.25000	.83658
.98746	.25000	.46474
.01254	.41318	5.66503
.10908	.41318	1.70542
.28306	.41318	.78709
.50000	.41318	1.18534
.71694	.41318	.92751
.89092	.41318	.86911
.98746	.41318	.56234
.01254	.58682	4.91002
.10908	.58682	3.88938
.28306	.58682	.83958
.50000	.58682	.57190
.71694	.58682	.76038
.89092	.58682	.49984
.98746	.58682	.39099
.01254	.75000	4.85511
.10908	.75000	4.20697
.28306	.75000	1.03986
.50000	.75000	.57927
.71694	.75000	.37819
.89092	.75000	.21812
.98746	.75000	-.07403
.01254	.88302	5.57029

.10908	.88302	4.99757
.28306	.88302	1.76241
.50000	.88302	1.00368
.71694	.88302	.00520
.89092	.88302	-.04567
.98746	.88302	-.63635
.01254	.96985	6.46233
.10908	.96985	6.35860
.28306	.96985	2.11451
.50000	.96985	1.84298
.71694	.96985	.57979
.89092	.96985	.35000
.98746	.96985	-.50505

SECTIONAL PROPERTIES
****

I	CL	CM	CD	CT
*	**	**	**	**
1	.81962	.23934	.48666	0.00000
2	1.24389	.40657	.67017	0.00000
3	.98137	-.02578	.52479	0.00000
4	1.02978	-.19773	.53115	0.00000
5	1.05218	-.31272	.47931	0.00000
6	.93987	-.41111	.34639	0.00000
7	1.01671	-.56347	.27208	0.00000
8	1.35887	-.87514	.28420	0.00000

TOTAL LIFT COEFFICIENT= 1.01587
TOTAL PITCHING MOMENT COEFFICIENT= -.03066
TOTAL DRAG COEFFICIENT= .51375
TOTAL THRUST COEFFICIENT= 0.00000

SPANWISE PRESSURE AT CONSTANT X=, -.40000

Y	2Y/B(LOCAL)	DELTA-CP
.02599	.07538	1.22605
.10083	.29244	.94703
.21550	.62500	.65597

SPANWISE PRESSURE AT CONSTANT X=, .41000

Y	2Y/B(LOCAL)	DELTA-CP
.02599	.04501	.58400
.10083	.17459	.79256
.21550	.37313	1.19617
.35616	.61668	1.10947
.50584	.87586	1.04922

SPANWISE PRESSURE AT CONSTANT X=, 1.20500

Y	2Y/B(LOCAL)	DELTA-CP
.02599	.03225	.40304
.10083	.12511	.64089
.21550	.26738	.89761
.35616	.44190	.86480
.50584	.62762	.54287
.64650	.80214	.31995
.76117	.94441	1.10036

Results for iterations 1 and 2 are omitted.

Initial Shape of the Free Sheet and Concentrated Core is shown in Iteration 3.

CONICAL CAMBER WING AT ALPHA 30.7 DEGREES

ALPHA(DEG.)=30.700 MACH NUMBER= 0.000 ITERATION NUMBER= 3

LEADING EDGE ELEMENTS

****

**** 1****

1.4000	-1.3639	-1.5624	-1.6000	-1.6000	-1.6000	-1.6000	-1.6000	-1.6000	-1.6000	-1.6000	-1.6000	-1.2316	-.6755
-.0534	.6895	1.6399	2.3086	3.0289	3.7492								
.0577	.0577	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.0656	.1647
.2755	.4079	.5344	.5344	.5344	.5344								
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.0805	.1151
.1926	.2852	.4035	.4868	.5765	.6662								

**** 2****

1.4000	-1.0333	-1.3639	-1.3990	-1.5390	-1.5251	-1.5108	-1.4959	-1.4801	-1.2316	-1.2316	-1.2316	-.6755	-.0534
.6895	1.6399	2.3086	3.0289	3.7492									
.1540	.1540	.0577	.0577	.0577	.0723	.0819	.0818	.0720	.0656	.0656	.0656	.1647	.2755
.4079	.5344	.5344	.5344	.5344									
0.0000	0.0000	0.0000	0.0000	0.0000	.0265	.0537	.0819	.1046	.1101	.0805	.0805	.1151	.1926
.2852	.4035	.4868	.5765	.6662									

**** 3****

1.4000	-.5878	-1.0333	-1.0642	-1.1874	-1.0932	-.9969	-.8962	-.7894	-.6755	-.6755	-.6755	-.0534	.6895
1.6399	2.3086	3.0289	3.7492										
.2836	.2836	.1540	.1540	.1540	.1929	.2185	.2182	.1919	.1509	.1509	.1647	.2755	.4079
.5344	.5344	.5344	.5344										
0.0000	0.0000	0.0000	0.0000	0.0000	.0707	.1432	.2184	.2789	.2935	.2104	.1151	.1926	.2852
.4035	.4868	.5765	.6662										

**** 4****

1.4000	-.0812	-.5878	-.6130	-.7137	-.6025	-.4782	-.3394	-.2001	-.0534	-.0534	-.0534	.6895	1.6399
2.3086	3.0289	3.7492											
.4310	.4310	.2836	.2836	.2836	.3260	.3444	.3262	.2783	.2244	.2244	.2755	.4079	.5344
.5344	.5344	.5344											
0.0000	0.0000	0.0000	0.0000	0.0000	.1107	.2078	.2884	.3609	.3897	.2564	.1926	.2852	.4035
.4868	.5765	.6662											

**** 5****

1.4000	.4254	-.0812	-.1000	-.1750	-.0450	.1341	.3159	.4958	.6895	.6895	.6895	1.6399	2.3086
3.0289	3.7492												
.5784	.5784	.4310	.4310	.4310	.4689	.4735	.4420	.3800	.3048	.3048	.4079	.5344	.5344
.5344	.5344												
0.0000	0.0000	0.0000	0.0000	0.0000	.1653	.2786	.3865	.4830	.5283	.3049	.2852	.4035	.4868
.5765	.6662												

**** 6****

1.4000	.8709	.4254	.4130	.3637	.5432	.8194	1.0799	1.3522	1.6399	1.6399	1.6399	2.3086	3.0289
3.7492													
.7080	.7080	.5784	.5784	.5784	.6077	.6042	.5526	.4705	.3837	.3837	.5344	.5344	.5344
.5344													
0.0000	0.0000	0.0000	0.0000	0.0000	.2405	.3891	.5482	.6719	.7466	.3847	.4035	.4868	.5765
.6662													

**** 7****

1.4000	1.2016	.8709	.8642	.8374	1.0374	1.3579	1.6649	1.9755	2.3086	2.3086	2.3086	3.0289	3.7492
.8043	.8043	.7080	.7080	.7080	.7265	.7105	.6434	.5422	.4455	.4455	.5344	.5344	.5344
0.0000	0.0000	0.0000	0.0000	0.0000	.2756	.4571	.6444	.8084	.9240	.5081	.4868	.5765	.6662

**** 8****

1.4000	1.3008	1.2016	1.1990	1.1890	1.4586	1.8571	2.2556	2.6364	3.0289	3.0289	3.0289	3.7492
.8620	.8331	.8043	.8043	.8043	.8302	.8263	.7769	.6450	.4887	.4887	.5344	.5344
0.0000	0.0000	0.0000	0.0000	0.0000	.3231	.5637	.8022	1.0380	1.2372	.6853	.5765	.6662

WAKE ELEMENTS
****

**** 1****

1.4000	1.7000	2.0000	2.7500	3.5000	4.2500	5.0000	5.7500
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 2****

1.4000	1.7000	1.9969	2.7369	3.4555	4.1320	4.7960	5.5259
.0577	.0577	.0994	.2185	.3784	.5440	.5655	.6050
0.0000	0.0000	-.0103	.0176	.1606	.4390	.7870	.9552

**** 3****

1.4000	1.7000	1.9876	2.7104	3.4257	4.1248	4.8049	5.4705
.1540	.1540	.2391	.4245	.5716	.6971	.7885	.7780
0.0000	0.0000	-.0060	.0692	.2402	.4809	.7836	1.1292

**** 4****

1.4000	1.7000	1.9716	2.6451	3.3086	4.0065	4.7278	5.4233
.2836	.2836	.4109	.7118	1.0212	1.0775	1.0775	1.0775
0.0000	0.0000	.0064	.1417	.3047	.5733	.7701	1.0596

**** 5****

1.4000	1.7000	1.9690	2.7036	3.3958	4.0762	4.7683	5.4337
.4310	.4310	.5571	.6937	.8938	1.0401	.9303	1.0075
0.0000	0.0000	.0414	.1063	.3147	.5941	.8613	1.1987

**** 6****

1.4000	1.7000	1.9815	2.6673	3.3790	4.1033	4.8165	5.4610
.5784	.5784	.6688	.9391	1.0775	1.0775	1.0775	1.0039
0.0000	0.0000	.0505	.1889	.3809	.5756	.8077	1.1842

**** 7****

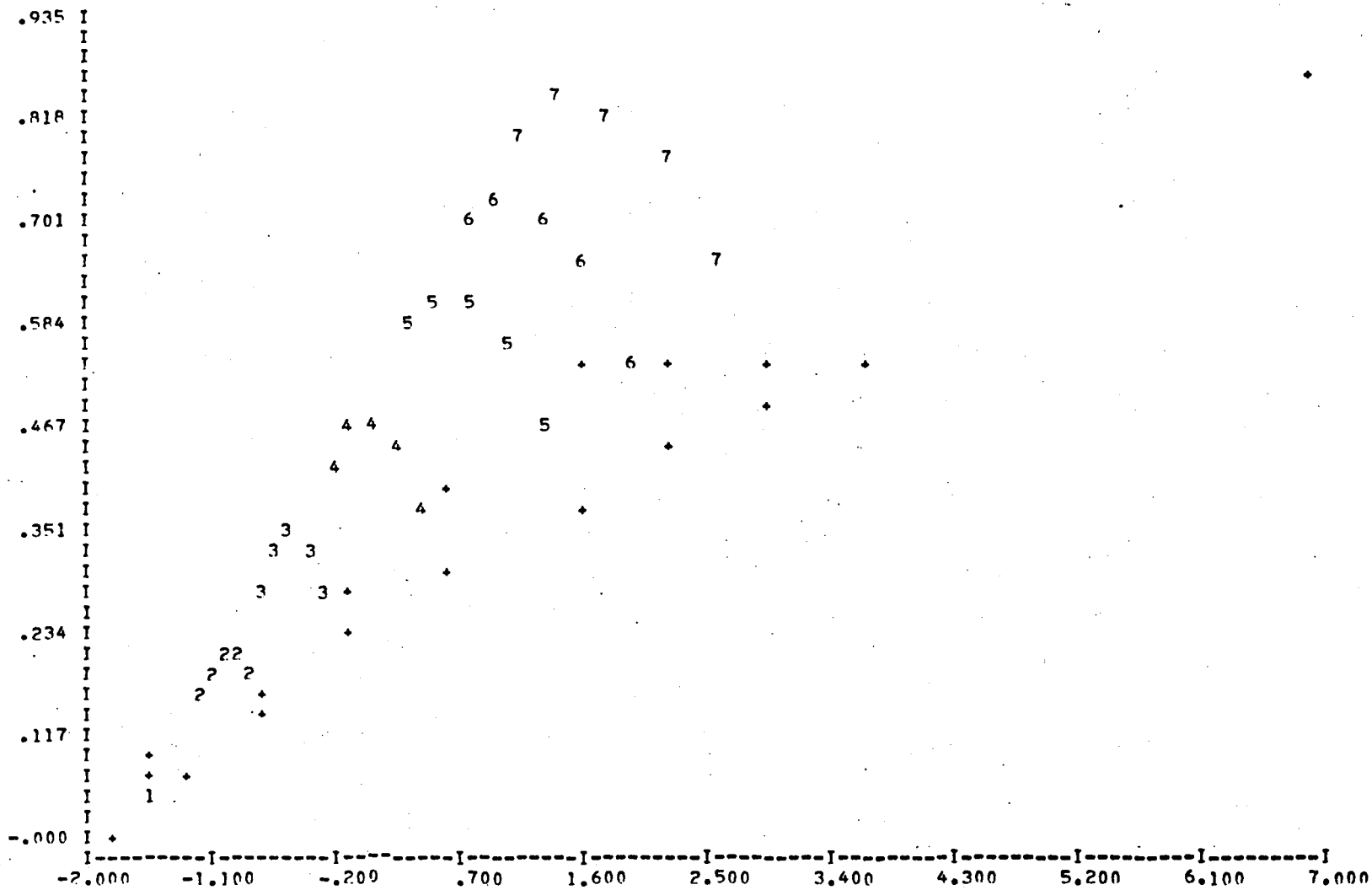
1.4000	1.7000	1.9842	2.6744	3.3636	4.0530	4.7559	5.4371
.7080	.7080	.7796	.9909	1.0775	1.0775	1.0775	1.0775
0.0000	0.0000	.0640	.2675	.5505	.8459	1.1076	1.4214

**** 8****

1.4000	1.7000	1.9735	2.6232	3.2764	3.9204	4.5599	5.2008
.8043	.8043	.8669	1.0362	1.0775	1.0452	.9616	.8604
0.0000	0.0000	.1060	.4404	.8067	1.1896	1.5725	1.9486

**** 9****

1.4000	1.7000	1.9522	2.5756	3.2153	3.9003	4.5757	5.2731
.8555	.8555	.9096	1.0747	.9933	.8853	.7305	.4737
0.0000	0.0000	.1532	.5361	.9190	1.2048	1.4918	1.5924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-2.000
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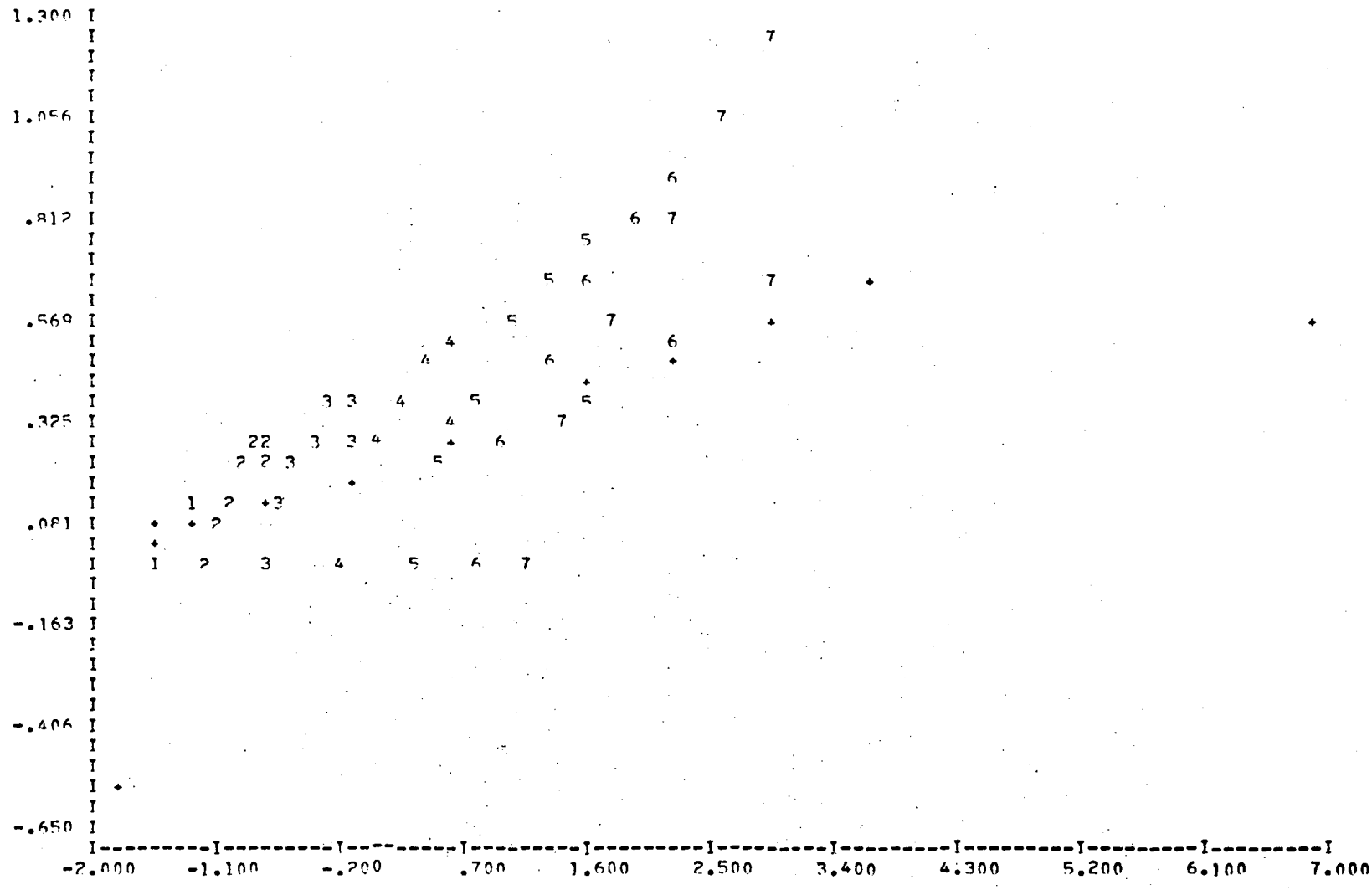
2.500
3.400
4.300
5.200
6.100
7.000

X VS Y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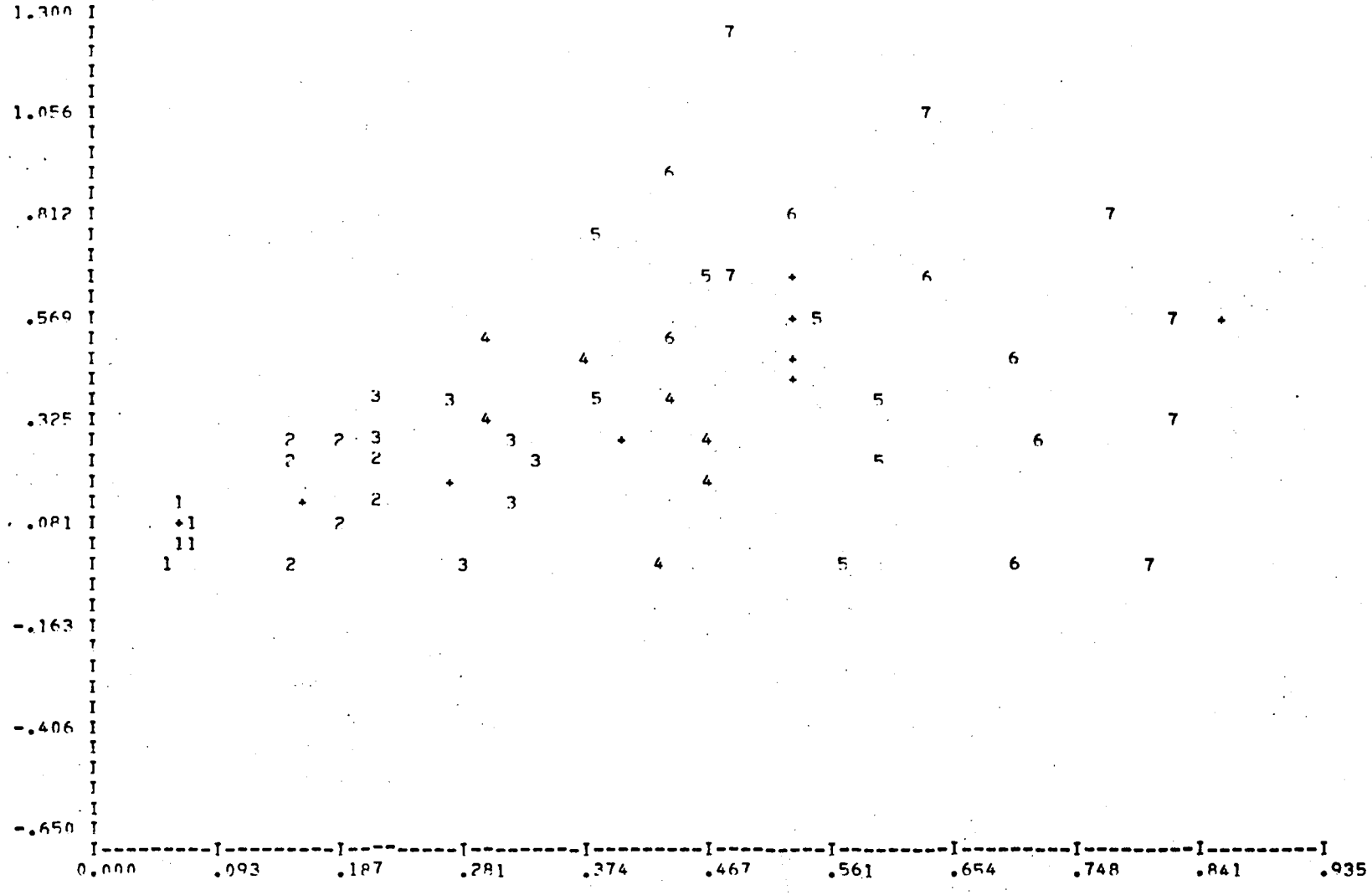
3.400
4.300
5.200
6.100
7.000

X VS Y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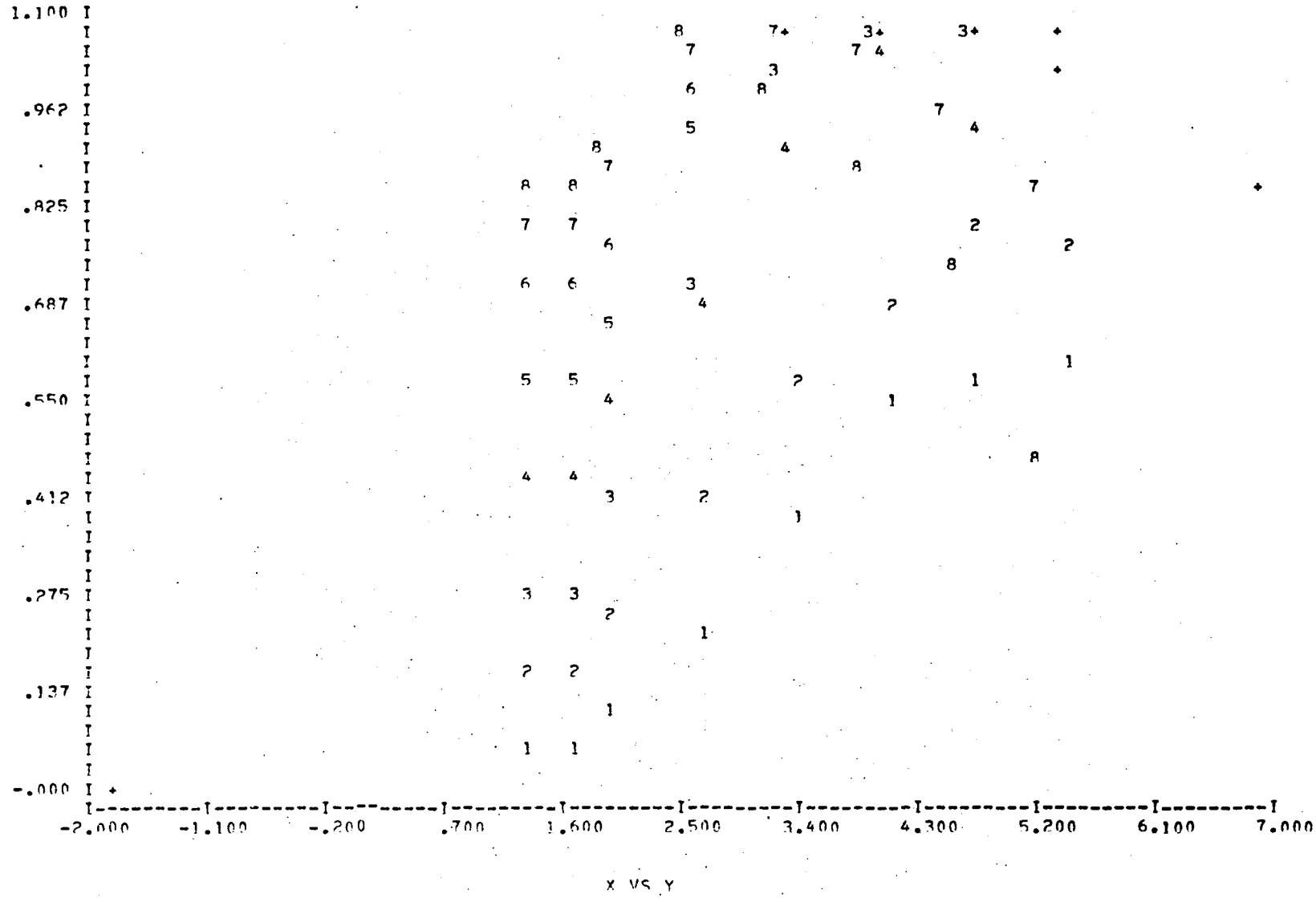
Y VS Z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6.100
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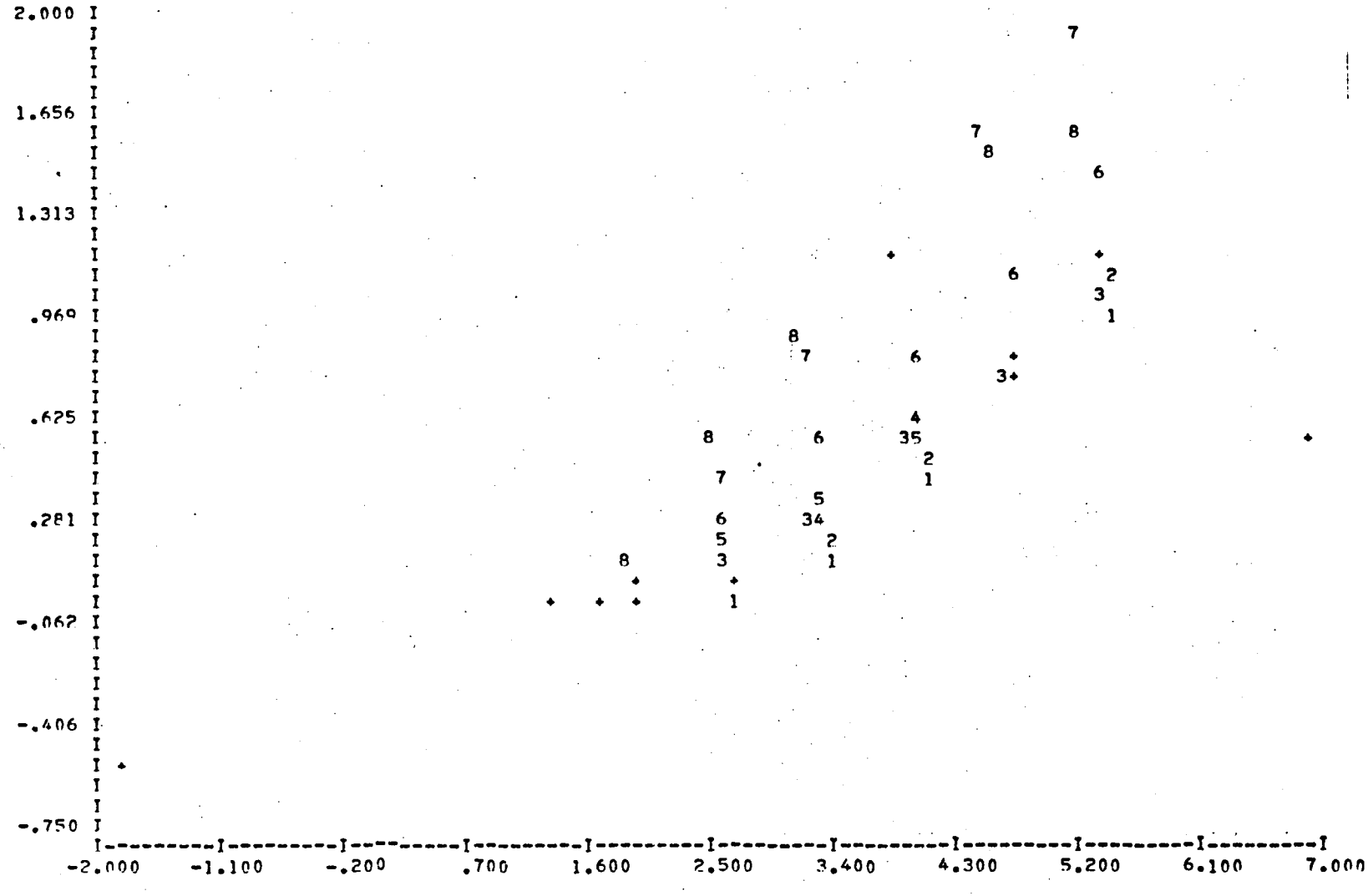
X VS Y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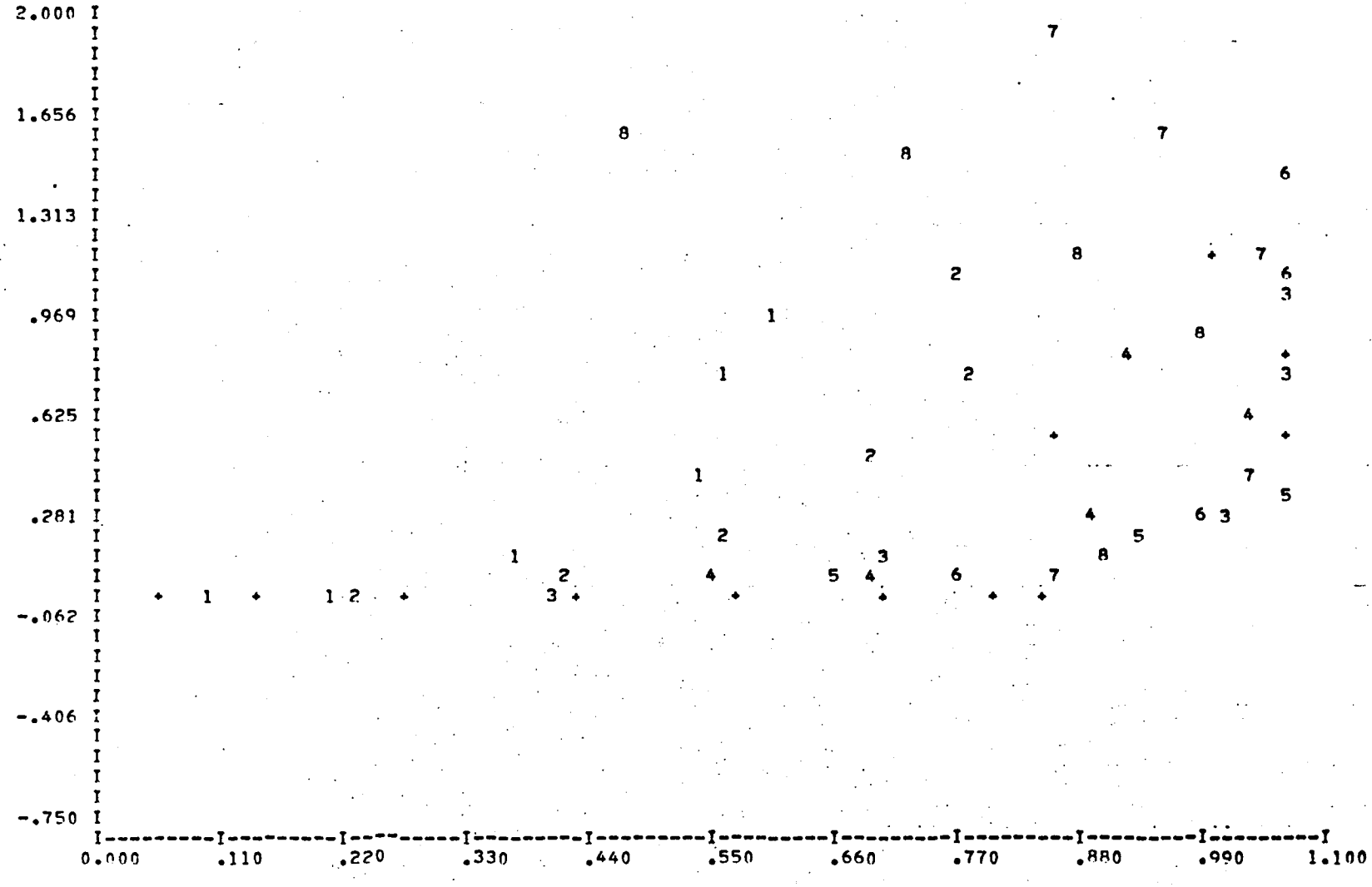
X VS 7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.330
.440
.550
.660
.770
.880
.990
1.100

Y VS 7

WING VORTEX STRENGTHS
****

X/C	2Y/B	GAMAY
***	****	*****
.01704	.03015	2.69948
.14645	.03015	.44077
.37059	.03015	.42606
.62941	.03015	.33144
.85355	.03015	.21837
.98296	.03015	.08506
.01704	.11698	1.60319
.14645	.11698	.28572
.37059	.11698	.41397
.62941	.11698	.33436
.85355	.11698	.22344
.98296	.11698	.08351
.01704	.25000	2.06415
.14645	.25000	.32235
.37059	.25000	.29850
.62941	.25000	.29331
.85355	.25000	.21136
.98296	.25000	.07323
.01704	.41318	2.53946
.14645	.41318	.47748
.37059	.41318	.23815
.62941	.41318	.21579
.85355	.41318	.16667
.98296	.41318	.05089
.01704	.58682	3.23341
.14645	.58682	.53154
.37059	.58682	.31264
.62941	.58682	.20575
.85355	.58682	.11987
.98296	.58682	.02939
.01704	.75000	3.92961
.14645	.75000	.54241
.37059	.75000	.45396
.62941	.75000	.28041
.85355	.75000	.13793
.98296	.75000	.03688
.01704	.88302	5.23080
.14645	.88302	.62764
.37059	.88302	.49692
.62941	.88302	.38249
.85355	.88302	.22302
.98296	.88302	.06904

.01704	.96985	8.10640
.14645	.96985	.87192
.37059	.96985	.58965
.62941	.96985	.47335
.85355	.96985	.32222
.98296	.96985	.11631

LEADING-EDGE VORTICES STRENGTHS
****

2Y/B	CAPGAMA
****	*******
.03015	.41388
.11698	.19614
.25000	.22825
.41318	.22664
.58682	.20691
.75000	.15402
.88302	.09673
.96985	.03885

DELTA-CP DISTRIBUTION

X/C	2Y/B	DELTA-CP
.01254	.03015	5.37273
.10908	.03015	1.20687
.28306	.03015	.76129
.50000	.03015	.73019
.71694	.03015	.52772
.89092	.03015	.38121
.98746	.03015	.14484
.01254	.11698	7.24640
.10908	.11698	2.50420
.28306	.11698	1.25580
.50000	.11698	.76442
.71694	.11698	.60438
.89092	.11698	.38654
.98746	.11698	.19248
.01254	.25000	2.59038
.10908	.25000	2.72487
.28306	.25000	2.20823
.50000	.25000	1.40225
.71694	.25000	.80584
.89092	.25000	.58850
.98746	.25000	.29099
.01254	.41318	3.49386
.10908	.41318	1.41421
.28306	.41318	1.55573
.50000	.41318	1.69482
.71694	.41318	1.11060
.89092	.41318	.93024
.98746	.41318	.54551
.01254	.58682	3.32251
.10908	.58682	2.27789
.28306	.58682	.80092
.50000	.58682	.91310
.71694	.58682	1.06551
.89092	.58682	.80414
.98746	.58682	.71854
.01254	.75000	3.53866
.10908	.75000	2.80547
.28306	.75000	.71763
.50000	.75000	.46314
.71694	.75000	.40929
.89092	.75000	.32594
.98746	.75000	.18231
.01254	.88302	4.22971

.10908	.88302	3.66379
.28306	.88302	1.15853
.50000	.88302	.51732
.71694	.88302	-.07571
.89092	.88302	-.15354
.98746	.88302	-.52354
.01254	.96985	4.66796
.10908	.96985	4.52855
.28306	.96985	1.53587
.50000	.96985	1.25348
.71694	.96985	.32264
.89092	.96985	.12931
.98746	.96985	-.50031

SECTIONAL PROPERTIES
****

I	CL	CM	CD	CT
*	**	**	**	**
1	.79292	.29097	.47080	0.00000
2	1.12264	.34315	.61919	0.00000
3	1.29834	.03883	.74537	0.00000
4	1.21109	-.28381	.66595	0.00000
5	.98632	-.37875	.49312	0.00000
6	.71392	-.33113	.27731	0.00000
7	.66261	-.35762	.16599	0.00000
8	.93610	-.60116	.19331	0.00000

TOTAL LIFT COEFFICIENT= 1.05961
TOTAL PITCHING MOMENT COEFFICIENT= -.03686
TOTAL DRAG COEFFICIENT= .57220
TOTAL THRUST COEFFICIENT= 0.00000

SPANWISE PRESSURE AT CONSTANT X=, -.40000

Y	2Y/B(LOCAL)	DELTA-CP
.02599	.07538	.76345
.10083	.29244	1.11946
.21550	.62500	2.51841

SPANWISE PRESSURE AT CONSTANT X=, .41000

Y	2Y/B(LOCAL)	DELTA-CP
.02599	.04501	.58770
.10083	.17459	.66697
.21550	.37313	1.20891
.35616	.61668	1.74667
.50584	.87586	1.29153

SPANWISE PRESSURE AT CONSTANT X=, 1.20500

Y	2Y/B(LOCAL)	DELTA-CP
.02599	.03225	.33228
.10083	.12511	.31834
.21550	.26738	.56316
.35616	.44190	.93004
.50584	.62762	.97366
.64650	.80214	.37784
.76117	.94441	.58189

Similar results for several iterations till " SFAC " value shows an increase (after fifth iteration) from previous value. (See summary sheet on next page)

The best solution is shown after summary sheet.

CONICAL CAMBER WING AT ALPHA 30.7 DEGREES

ALPHA(DEG.)=30.700 MACH NUMBER= 0.000

ITERATION	CL	CM	CD	CT	GMSUM	SFAC
*********	**	**	**	**	*****	****
0	1.0159	-.0307	.5137	0.0000	1.8554	
1	1.1006	-.0546	.5647	0.0000	1.8292	
2	1.1297	-.0925	.5834	0.0000	1.8104	
3	1.0596	-.0369	.5722	0.0000	1.1475	.6443
4	1.2647	-.0083	.6917	0.0000	1.1958	.7056
5	1.3036	-.0050	.7138	0.0000	1.2094	.7195
6	1.3058	-.0051	.7150	0.0000	1.2108	.7159
7	1.3071	-.0054	.7157	0.0000	1.2113	.7181

CONICAL CAMBER WING AT ALPHA 30.7 DEGREES

ALPHA(DEG.)=30.700 MACH NUMBER= 0.000 ITERATION NUMBER= 6

LEADING EDGE ELEMENTS

****

```
**** 1****
  1.4000  -1.3639  -1.5624  -1.6000  -1.6000  -1.6000  -1.6000  -1.6000  -1.6000  -1.6000  -1.6000  -1.6000  -1.2316   -.6744
   -.0517    .6914   1.6433   2.3156   3.0410   3.7669
    .0577    .0577   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000    .0651    .1637
    .2739    .4059    .5322    .5307    .5297    .5296
  0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000    .0643    .0920
    .1657    .2571    .3635    .4090    .4340    .4381
**** 2****
  1.4000  -1.0333  -1.3639  -1.3990  -1.5390  -1.4139  -1.3789  -1.3408  -1.2997  -1.2573  -1.2573  -1.2316   -.6744   -.0517
    .6914   1.6433   2.3156   3.0410   3.7669
    .1540    .1540    .0577    .0577    .0577    .0825    .0848    .0755    .0608    .0448    .0448    .0651    .1637    .2739
    .4059    .5322    .5307    .5297    .5296
  0.0000   0.0000   0.0000   0.0000   0.0000    .0238    .0539    .0801    .0977    .1039    .0727    .0643    .0920    .1657
    .2571    .3635    .4090    .4340    .4381
**** 3****
  1.4000   -.5878  -1.0333  -1.0642  -1.1874  -1.1038  -1.0104   -.9089   -.7993   -.6863   -.6863   -.6744   -.0517    .6914
   1.6433   2.3156   3.0410   3.7669
    .2836    .2836    .1540    .1540    .1540    .2200    .2260    .2013    .1621    .1195    .1195    .1637    .2739    .4059
    .5322    .5307    .5297    .5296
  0.0000   0.0000   0.0000   0.0000   0.0000    .0635    .1437    .2136    .2606    .2771    .1940    .0920    .1657    .2571
    .3635    .4090    .4340    .4381
**** 4****
  1.4000   -.0812   -.5878   -.6130   -.7137   -.6068   -.4932   -.3669   -.2264   -.0804   -.0804   -.0517    .6914   1.6433
   2.3156   3.0410   3.7669
    .4310    .4310    .2836    .2836    .2836    .3470    .3417    .2934    .2264    .1645    .1645    .2739    .4059    .5322
    .5307    .5297    .5296
  0.0000   0.0000   0.0000   0.0000   0.0000    .1048    .2155    .3038    .3562    .3658    .2325    .1657    .2571    .3635
    .4090    .4340    .4381
**** 5****
  1.4000    .4254   -.0812   -.1000   -.1750   -.0385    .1093    .2709    .4517    .6467    .6467    .6914   1.6433   2.3156
   3.0410   3.7669
    .5784    .5784    .4310    .4310    .4310    .4932    .4825    .4079    .3123    .2274    .2274    .4059    .5322    .5307
    .5297    .5296
  0.0000   0.0000   0.0000   0.0000   0.0000    .1522    .3037    .4221    .4827    .4858    .2624    .2571    .3635    .4090
    .4340    .4381
**** 6****
  1.4000    .8709    .4254    .4130    .3637    .5609    .7806   1.0206   1.2932   1.5847   1.5847   1.6433   2.3156   3.0410
   3.7669
    .7080    .7080    .5784    .5784    .5784    .6415    .6142    .4915    .3593    .2548    .2548    .5322    .5307    .5297
    .5296
  0.0000   0.0000   0.0000   0.0000   0.0000    .2191    .4414    .5937    .6597    .6638    .3019    .3635    .4090    .4340
    .4381
```

**** 7****

1.4000	1.2016	.8709	.8642	.8374	1.0677	1.3259	1.6041	1.9136	2.2479	2.2479	2.3156	3.0410	3.7669
.8043	.8043	.7080	.7080	.7080	.7650	.7516	.6329	.4875	.3642	.3642	.5307	.5297	.5296
0.0000	0.0000	0.0000	0.0000	0.0000	.2450	.5078	.7135	.8428	.9247	.5088	.4090	.4340	.4381

**** 8****

1.4000	1.3008	1.2016	1.1990	1.1890	1.4857	1.8182	2.1826	2.5752	2.9903	2.9903	3.0410	3.7669
.8620	.8331	.8043	.8043	.8043	.8705	.8542	.7426	.6036	.4822	.4822	.5297	.5296
0.0000	0.0000	0.0000	0.0000	0.0000	.2921	.6175	.8875	1.0986	1.2750	.7231	.4340	.4381

WAKE ELEMENTS
****

**** 1****

1.4000	1.7000	2.0000	2.7500	3.5000	4.2500	5.0000	5.7500
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 2****

1.4000	1.7000	1.9984	2.7365	3.4298	3.9714	4.6104	5.2510
.0577	.0577	.0871	.2198	.5006	.8507	.9376	1.0114
0.0000	0.0000	.0100	.0224	.0766	.4595	.8425	1.2254

**** 3****

1.4000	1.7000	1.9905	2.6697	3.2258	3.8442	4.4285	5.1233
.1540	.1540	.2280	.5379	.8645	.6816	.3441	.0959
0.0000	0.0000	.0102	.0822	.4651	.8480	1.1754	1.3100

**** 4****

1.4000	1.7000	1.9693	2.4627	3.0583	3.7053	4.3682	5.0568
.2836	.2836	.4142	.8534	.6062	.5002	.3561	.2851
0.0000	0.0000	.0205	.3756	.7585	1.1229	1.4426	1.7311

**** 5****

1.4000	1.7000	1.9467	2.5430	3.1875	3.8371	4.5017	5.1681
.4310	.4310	.5966	.8818	.9037	.7978	.6282	.4016
0.0000	0.0000	.0415	.3958	.7787	1.1384	1.4417	1.7008

**** 6****

1.4000	1.7000	1.9548	2.5881	3.2330	3.8837	4.4696	5.1204
.5784	.5784	.7300	.9768	.9850	.7823	.4663	.1493
0.0000	0.0000	.0456	.3627	.7456	1.0586	1.4042	1.6001

**** 7****

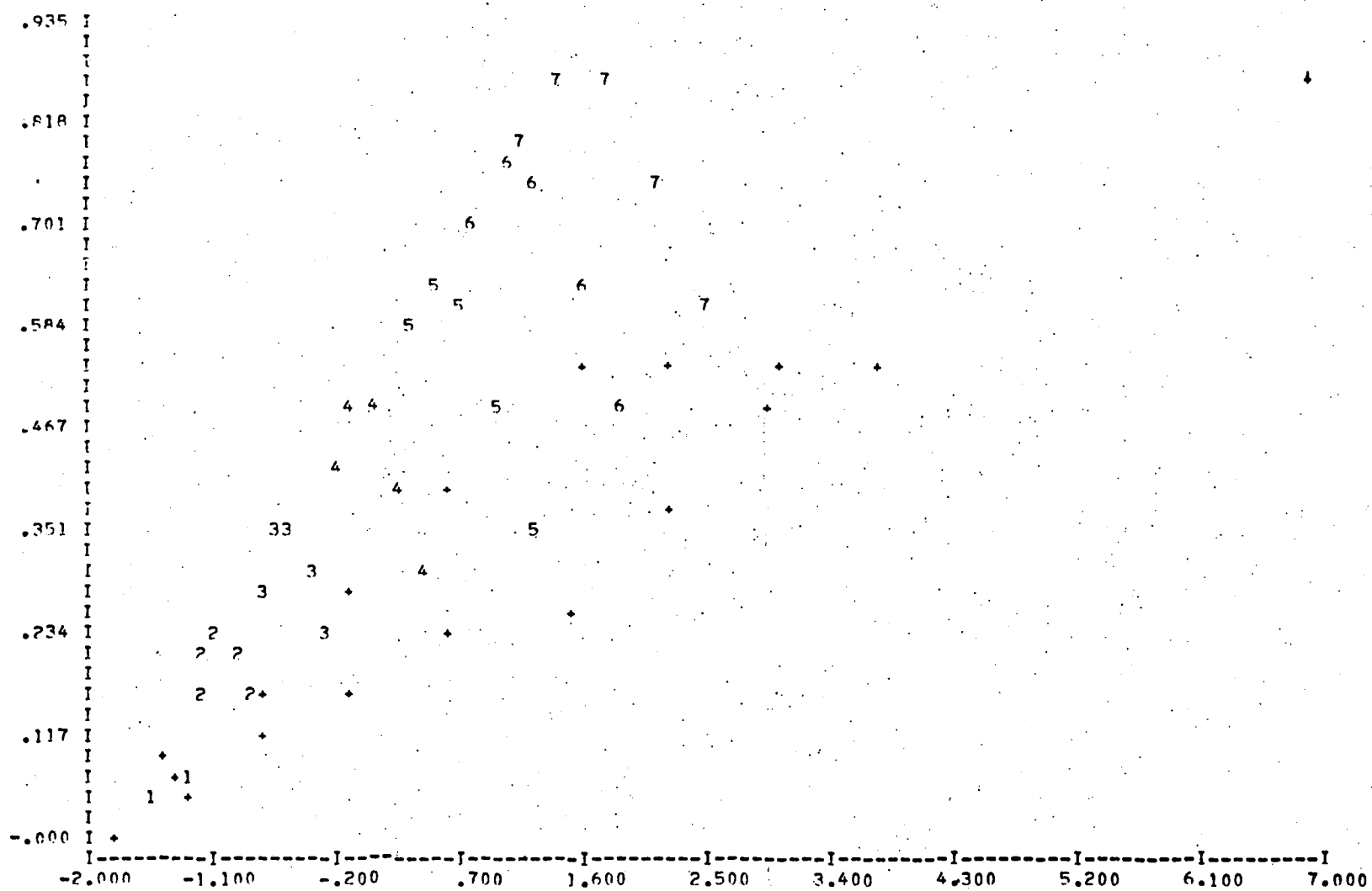
1.4000	1.7000	1.9629	2.5980	3.2512	3.9097	4.5449	5.1788
.7080	.7080	.8397	1.0667	1.0664	.9689	.8200	.6096
0.0000	0.0000	.0596	.3877	.7562	1.1017	1.4716	1.8128

**** 8****

1.4000	1.7000	1.9428	2.5755	3.2199	3.8597	4.5017	5.1481
.8043	.8043	.9469	1.0718	1.0466	.9547	.8228	.6678
0.0000	0.0000	.1035	.4864	.8693	1.2497	1.6142	1.9615

**** 9****

1.4000	1.7000	1.9688	2.6000	3.2497	3.9305	4.6164	5.2689
.8555	.8555	.8721	1.0042	.9498	.8699	.7203	.4018
0.0000	0.0000	.1321	.5150	.8859	1.1901	1.4541	1.6418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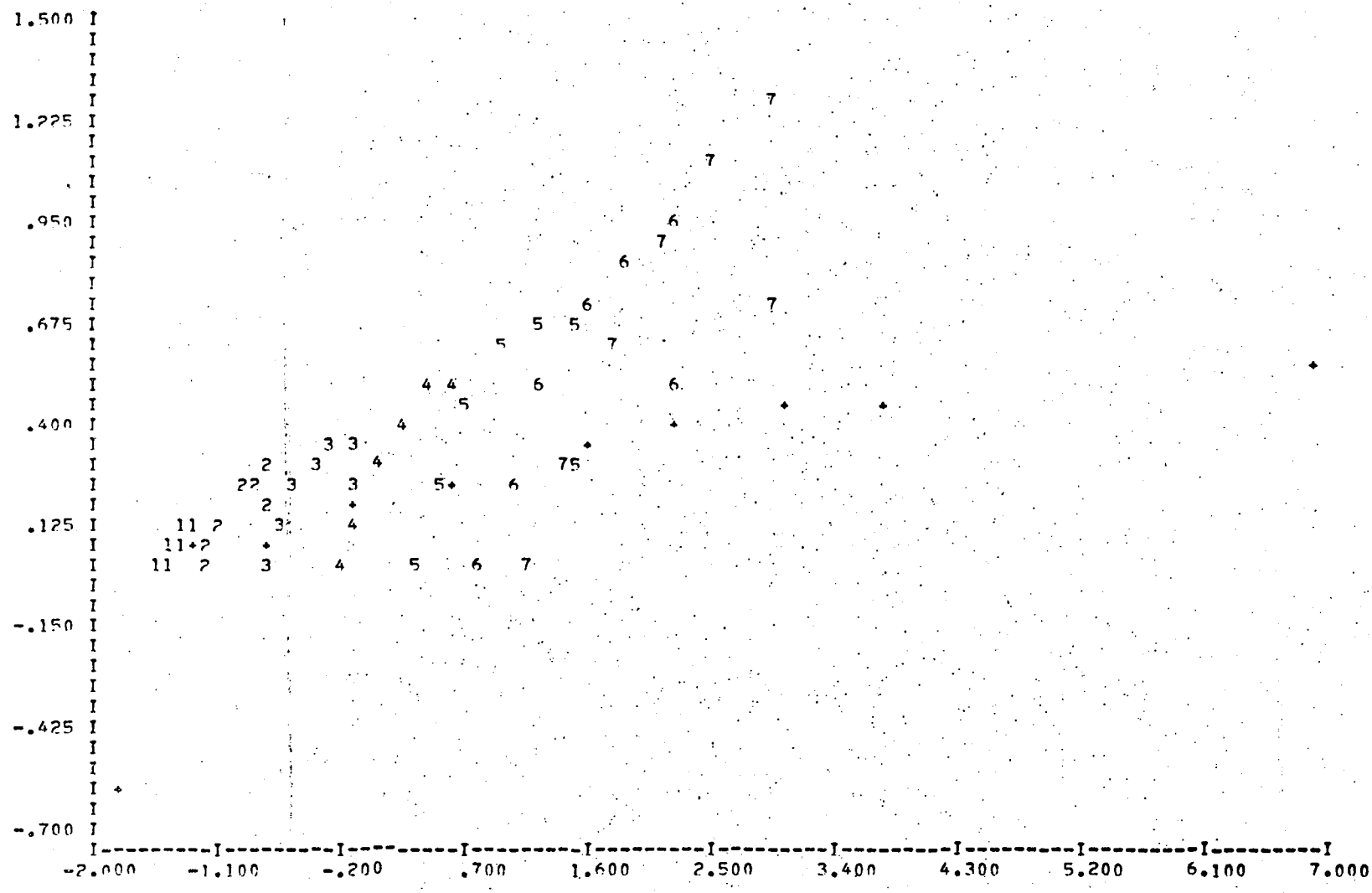
X VS Y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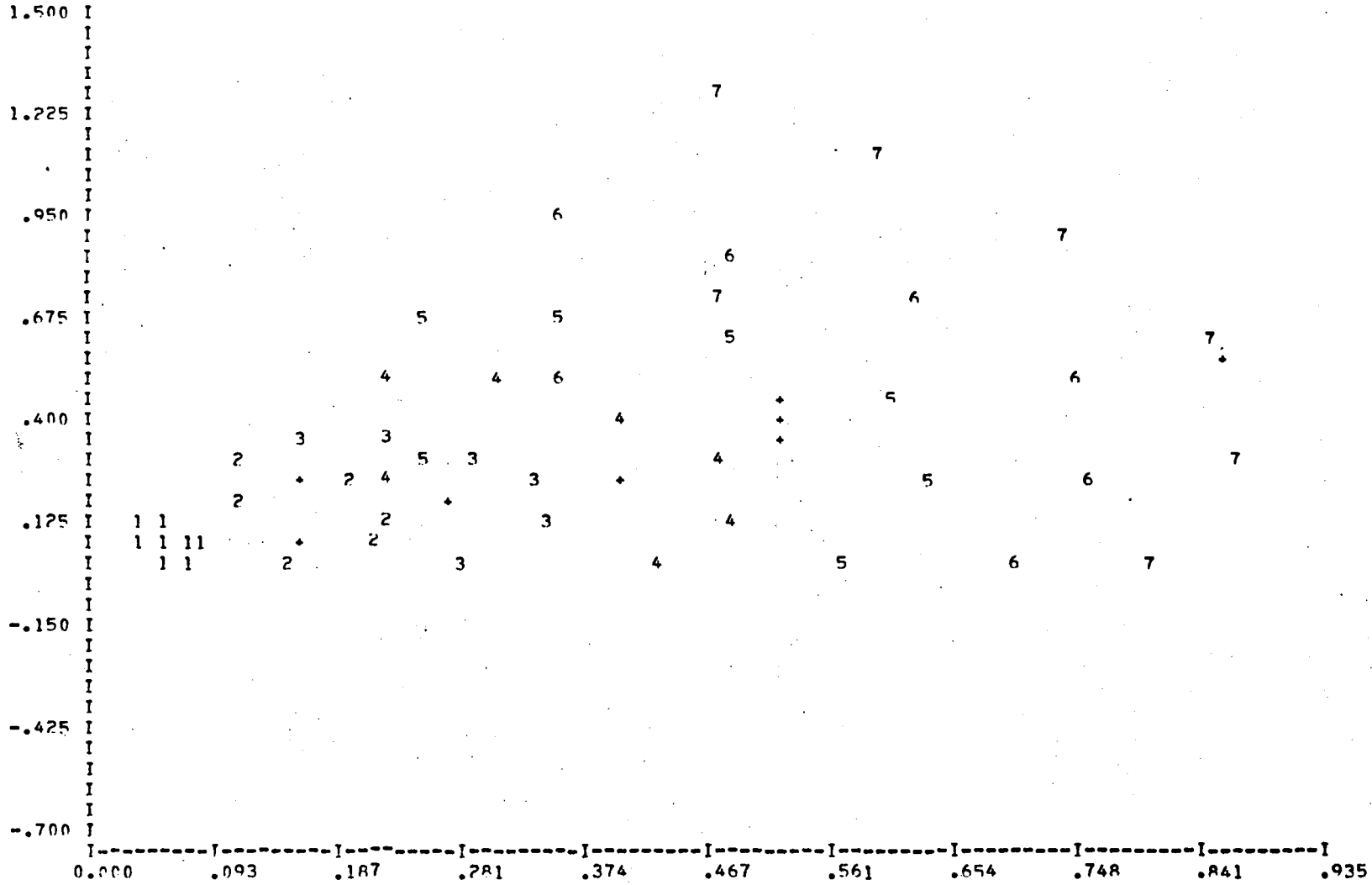
X VS Z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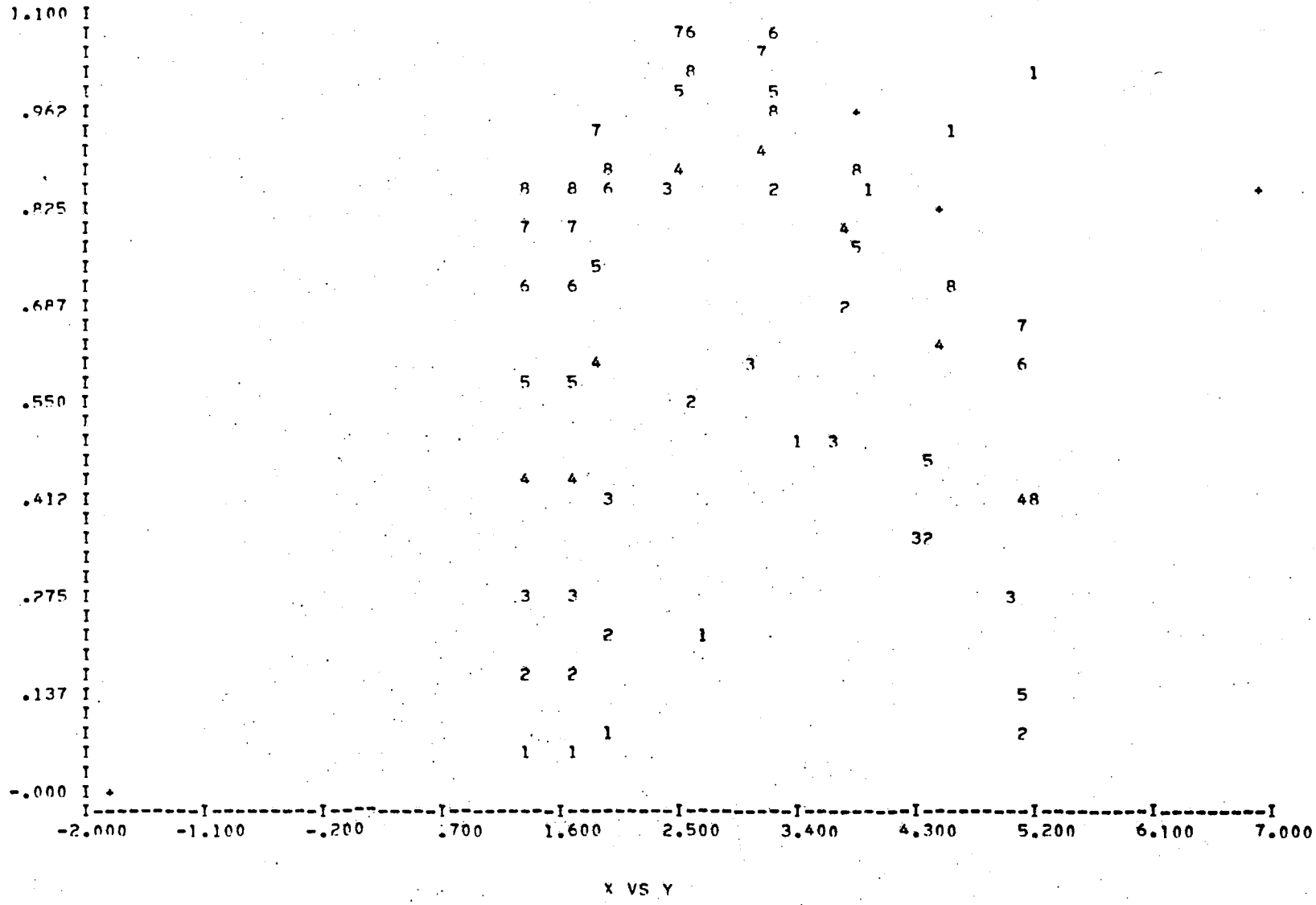
Y VS 7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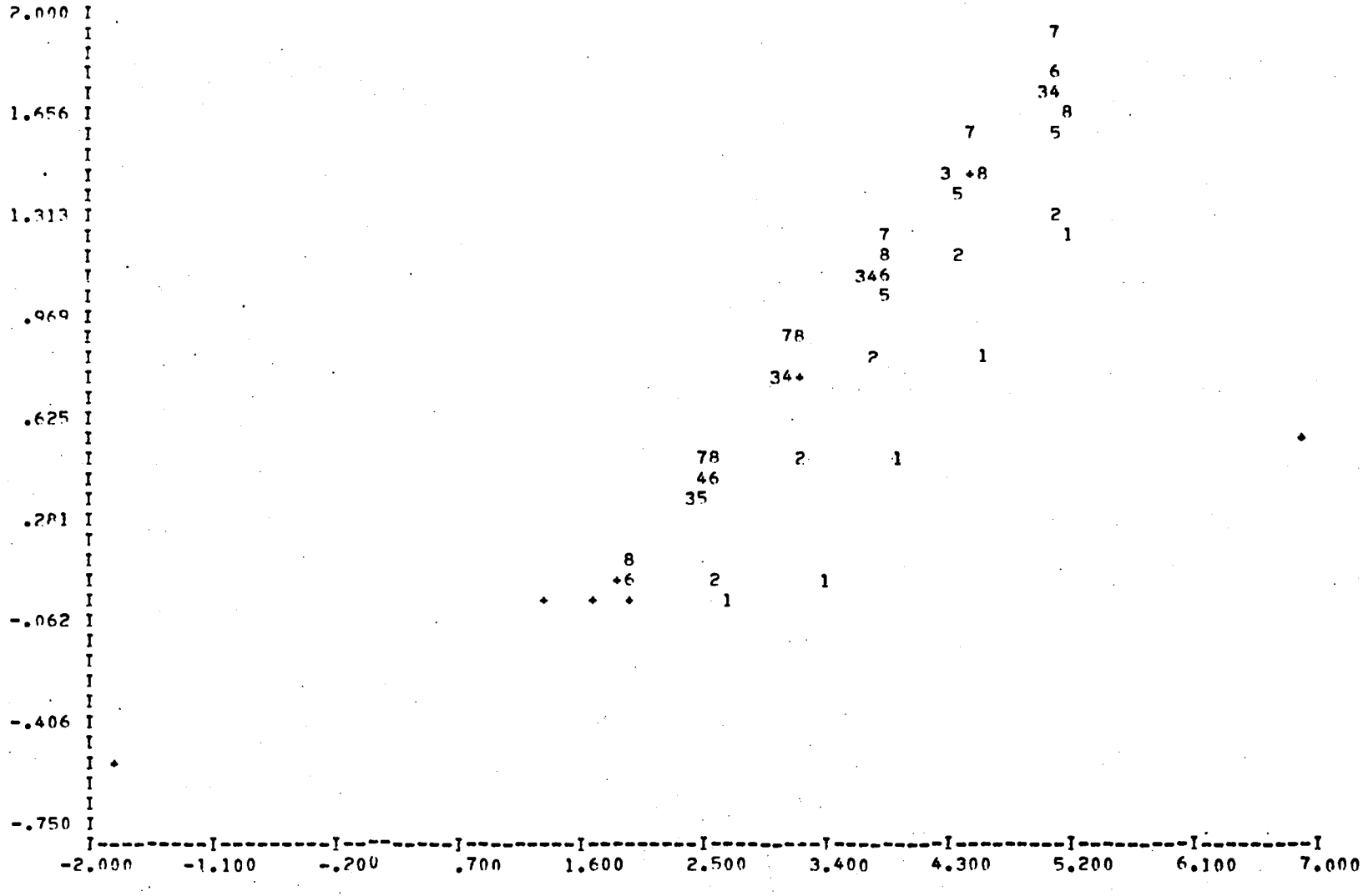
X VS Y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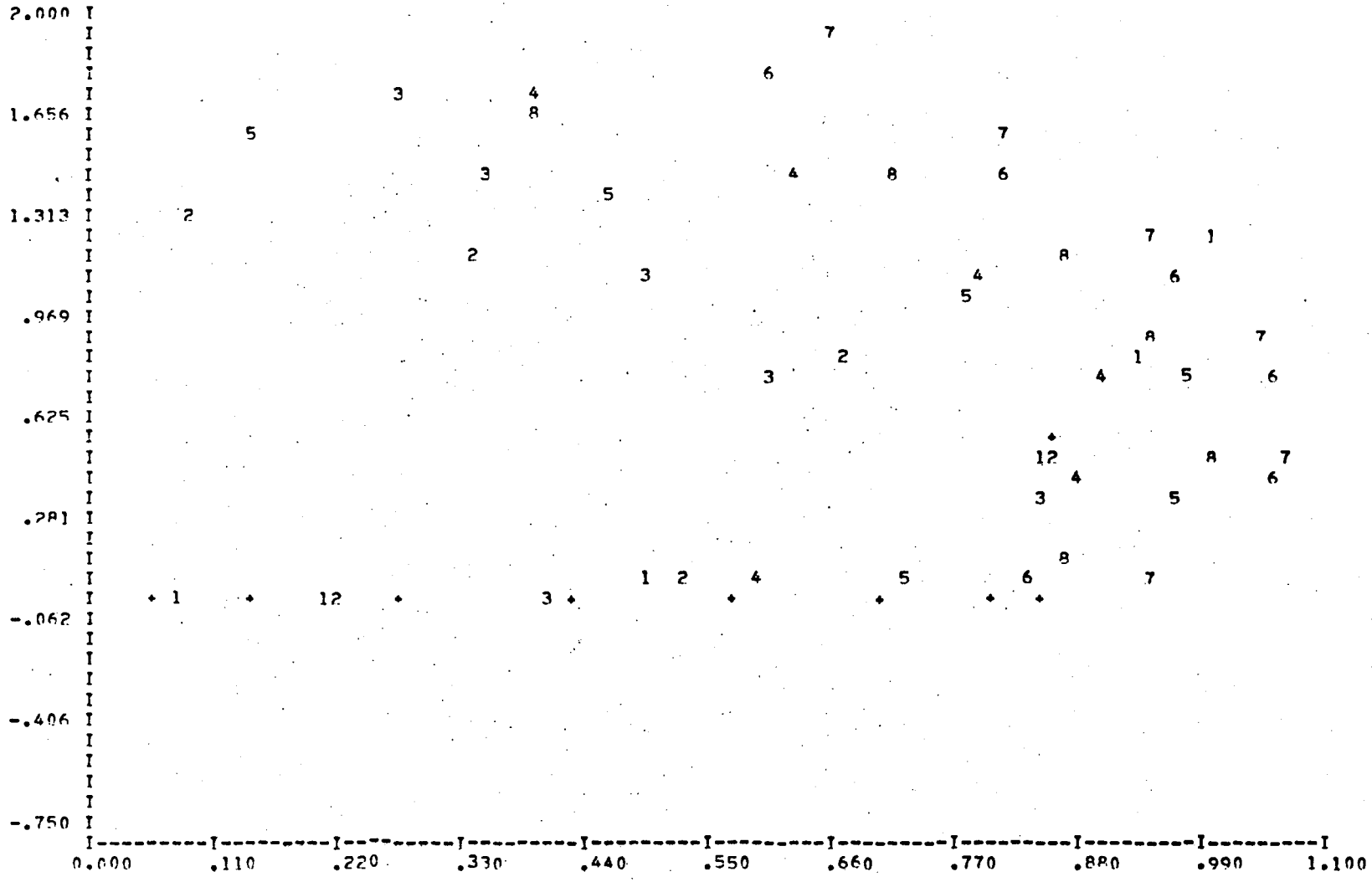
X VS Z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.220
.330
.440
.550
.660
.770
.880
.990
1.100

Y VS Z

WING VORTEX STRENGTHS
****

X/C	2Y/B	GAMAY
***	****	*****
.01704	.03015	2.42231
.14645	.03015	.46682
.37059	.03015	.43532
.62941	.03015	.33450
.85355	.03015	.21936
.98296	.03015	.08180
.01704	.11698	1.72066
.14645	.11698	.23409
.37059	.11698	.42675
.62941	.11698	.33703
.85355	.11698	.22520
.98296	.11698	.08031
.01704	.25000	2.28950
.14645	.25000	.26095
.37059	.25000	.27138
.62941	.25000	.20508
.85355	.25000	.21341
.98296	.25000	.07034
.01704	.41318	2.66610
.14645	.41318	.45586
.37059	.41318	.19710
.62941	.41318	.18512
.85355	.41318	.15992
.98296	.41318	.04560
.01704	.58682	3.28069
.14645	.58682	.51592
.37059	.58682	.29484
.62941	.58682	.18002
.85355	.58682	.10288
.98296	.58682	.02015
.01704	.75000	3.93349
.14645	.75000	.53743
.37059	.75000	.44080
.62941	.75000	.27561
.85355	.75000	.12935
.98296	.75000	.03276
.01704	.88302	5.22320
.14645	.88302	.62623
.37059	.88302	.48116
.62941	.88302	.37978
.85355	.88302	.22428
.98296	.88302	.06973

.01704	.96985	8.11529
.14645	.96985	.87299
.37059	.96985	.59069
.62941	.96985	.47464
.85355	.96985	.32345
.98296	.96985	.11680

LEADING-EDGE VORTICES STRENGTHS
****

2Y/B	CAPGAMA
****	*******
.03015	.37658
.11698	.21708
.25000	.25493
.41318	.23887
.58682	.21018
.75000	.15420
.88302	.09659
.96985	.03889

DELTA-CP DISTRIBUTION
****

X/C	2Y/B	DELTA-CP
.01254	.03015	6.98806
.10908	.03015	1.60492
.28306	.03015	.84178
.50000	.03015	.74088
.71694	.03015	.54086
.89092	.03015	.37889
.98746	.03015	.14148
.01254	.11698	9.54001
.10908	.11698	3.98147
.28306	.11698	1.73228
.50000	.11698	.72563
.71694	.11698	.67064
.89092	.11698	.34810
.98746	.11698	.23262
.01254	.25000	2.54033
.10908	.25000	4.04777
.28306	.25000	3.10560
.50000	.25000	1.67312
.71694	.25000	.91018
.89092	.25000	.63678
.98746	.25000	.34692
.01254	.41318	3.55714
.10908	.41318	1.60558
.28306	.41318	2.01749
.50000	.41318	2.13332
.71694	.41318	1.36905
.89092	.41318	1.15988
.98746	.41318	.71547
.01254	.58682	3.37465
.10908	.58682	2.22913
.28306	.58682	.84266
.50000	.58682	1.08304
.71694	.58682	1.30806
.89092	.58682	1.04583
.98746	.58682	.99100
.01254	.75000	3.62387
.10908	.75000	2.80979
.28306	.75000	.72867
.50000	.75000	.48655
.71694	.75000	.46319
.89092	.75000	.39202
.98746	.75000	.28355
.01254	.88302	4.28095

.10908	.88302	3.67314
.28306	.88302	1.13856
.50000	.88302	.46677
.71694	.88302	-.09444
.89092	.88302	-.17557
.98746	.88302	-.53312
.01254	.96985	4.59738
.10908	.96985	4.44246
.28306	.96985	1.51496
.50000	.96985	1.21636
.71694	.96985	.29743
.89092	.96985	.10011
.98746	.96985	-.52598

SECTIONAL PROPERTIES
****

I	CL	CM	CD	CT
*	**	**	**	**
1	.92808	.38875	.55105	0.00000
2	1.47793	.52553	.81515	0.00000
3	1.69031	.09114	.97860	0.00000
4	1.48083	-.36202	.82349	0.00000
5	1.10559	-.45157	.56406	0.00000
6	.74497	-.35166	.29396	0.00000
7	.64718	-.34701	.15941	0.00000
8	.91155	-.58499	.18766	0.00000

TOTAL LIFT COEFFICIENT= 1.30585
TOTAL PITCHING MOMENT COEFFICIENT= -.00512
TOTAL DRAG COEFFICIENT= .71502
TOTAL THRUST COEFFICIENT= 0.00000

SPANWISE PRESSURE AT CONSTANT X=, -.40000

Y	2Y/B(LOCAL)	DELTA-CP
.02599	.07538	.79051
.10083	.29244	1.43394
.21550	.62500	3.71329

SPANWISE PRESSURE AT CONSTANT X=, .41000

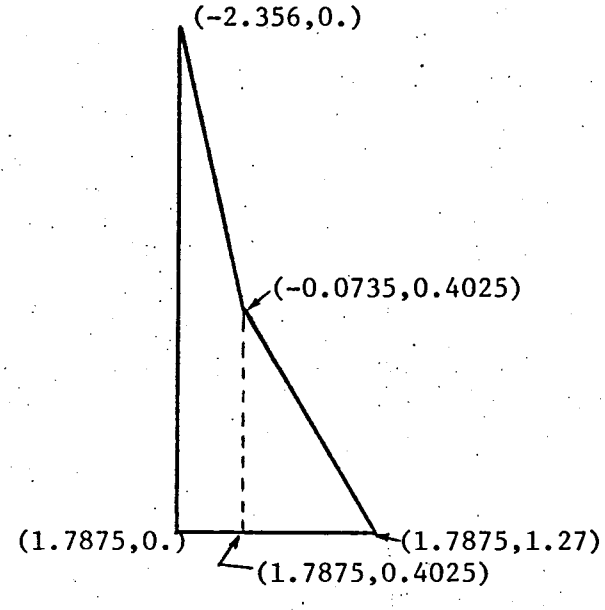
Y	2Y/B(LOCAL)	DELTA-CP
.02599	.04501	.60152
.10083	.17459	.67754
.21550	.37313	1.39777
.35616	.61668	2.22570
.50584	.87586	1.28191

SPANWISE PRESSURE AT CONSTANT X=, 1.20500

Y	2Y/B(LOCAL)	DELTA-CP
.02599	.03225	.32623
.10083	.12511	.23926
.21550	.26738	.60064
.35616	.44190	1.15861
.50584	.62762	1.12205
.64650	.80214	.43497
.76117	.94441	.53250

2. Input Data of the Second Sample Case

```
                                    C O L U M N   N U M B E R
                  11111111112222222222333333333344444444445555555555666666666677777777778
            12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD NUMBER
     1                                DOUBLE DELTA WING MODEL ONE (SCALING)
     2          6     2     0     8     0     2
     3          2     5     5     0     1     0
     4          0     2
     5     20.0       0.         0.6        1.2        6.0        2.3835     4.03       0.9
     6          5     5     5     5     5     5     5     5     5
     7     0.         1.0
     8     0.         0.         0.         0.         0.         0.         0.         0.
     9     0.
    10     -2.356     1.7875     0.         -0.0735    1.7875     0.4025
    11     -0.0735    1.7875     0.4025     1.7875     1.7875     1.27
    12     -2.356     1.7875     0.         -0.0735    1.7875     0.4025
    13     -0.0735    1.7875     0.4025     1.7875     1.7875     1.27
    14     END
```



Output of the Second Sample Case

```
INPUT DATA CARDS
                    DOUBLE DELTA WING MODEL ONE (SCALING)
   6     2     0     8     0     2
   2     5     6     0     1     0
   0     2
 20.00000   0.00000    .60000   1.20000   6.00000   2.38350   4.03000    .90000
   5     5     5     5     5     5     5     5     5
  0.00000   1.00000
  0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  0.00000
 SAPNWISE SECTION OF NUMBER     1
 -2.35600   1.78750   0.00000   -.07350   1.78750    .40250
 SAPNWISE SECTION OF NUMBER     2
  -.07350   1.78750    .40250   1.78750   1.78750   1.27000

 CAMBER SLOPE AT FINE GRID BOUND ELEMENT

   DZDXV     DZDYV
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
  0.00000   0.00000
```

```
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
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 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
 0.00000    0.00000
SAPNWISE SECTION OF NUMPER    1
-2.35600   1.78750   0.00000   -.07350   1.78750    .40250
SAPNWISE SECTION OF NUMPER    2
 -.07350   1.78750    .40250   1.78750   1.78750   1.27000

CAMBER SLOPE AT COARSE GRID ROUND ELEMENT

  DZDX       DZDY      DZDYV
 0.00000    0.00000   0.00000
 0.00000    0.00000   0.00000
 0.00000    0.00000   0.00000
 0.00000    0.00000   0.00000
 0.00000    0.00000   0.00000
 0.00000    0.00000   0.00000
 0.00000    0.00000   0.00000
 0.00000    0.00000   0.00000
```

0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
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0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
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0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000
0.00000	0.00000	0.00000

CAMBER SLOPE AT THE LEADING EDGE CONTROL POINTS

DZDX	DZDY
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000

END OF INPUT DATA

```
                    DOUBLE DELTA WING MODEL ONE (SCALING)
ALPHA(DEG.)=20.000  MACH NUMBER= 0.000  ITERATION NUMBER= 0

LEADING EDGE ELEMENTS
*********************
 **** 1****
   1.7875  -1.8395  -2.3041  -2.3560  -2.5632  -2.1488  -1.5850
    .0830    .0830   0.0000   0.0000   0.0000   0.0000   0.0000
   0.0000   0.0000   0.0000   0.0000   0.0000    .1508    .3560
 **** 2****
   1.7875  -1.1771  -1.8395  -1.8856  -2.0692  -1.7019  -1.1381   -.5381    .0619    .6619   1.2619   1.8619   2.4619   3.0619
   3.6619   4.2619   4.8619   5.4619   6.0619
    .2012    .2012    .0830    .0830    .0830    .0830    .0830    .0830    .0830    .0830    .0830    .0830    .0830    .0830
    .0830    .0830    .0830    .0830    .0830
   0.0000   0.0000   0.0000   0.0000   0.0000    .1508    .3560    .3560    .3560    .3560    .3560    .3560    .3560    .3560
    .3560    .3560    .3560    .3560    .3560
 **** 3****
   1.7875   -.5147  -1.1771  -1.2148  -1.3649  -1.0646   -.5008    .0992    .6992   1.2992   1.8992   2.4992   3.0992   3.6992
   4.2992   4.8992   5.4992   6.0992
    .3195    .3195    .2012    .2012    .2012    .2012    .2012    .2012    .2012    .2012    .2012    .2012    .2012    .2012
    .2012    .2012    .2012    .2012
   0.0000   0.0000   0.0000   0.0000   0.0000    .1508    .3560    .3560    .3560    .3560    .3560    .3560    .3560    .3560
    .3560    .3560    .3560    .3560
 **** 4****
   1.7875   -.0502   -.5147   -.5439   -.6605   -.4274    .1364    .7364   1.3364   1.9364   2.5364   3.1364   3.7364   4.3364
   4.9364   5.5364   6.1364
    .4025    .4025    .3195    .3195    .3195    .3195    .3195    .3195    .3195    .3195    .3195    .3195    .3195    .3195
    .3195    .3195    .3195
   0.0000   0.0000   0.0000   0.0000   0.0000    .1508    .3560    .3560    .3560    .3560    .3560    .3560    .3560    .3560
    .3560    .3560    .3560
 **** 5****
   1.7875    .2190   -.0502   -.0735   -.1666    .0195    .5834   1.1834   1.7834   2.3834   2.9834   3.5834   4.1834   4.7834
   5.3834   5.9834   6.5834
    .5295    .5295    .4025    .4025    .4025    .4025    .4025    .4025    .4025    .4025    .4025    .4025    .4025    .4025
    .4025    .4025    .4025
   0.0000   0.0000   0.0000   0.0000   0.0000    .1508    .3560    .3560    .3560    .3560    .3560    .3560    .3560    .3560
    .3560    .3560    .3560
 **** 6****
   1.7875    .6309    .2190    .1990    .1196    .2785    .8423   1.4423   2.0423   2.6423   3.2423   3.8423   4.4423   5.0423
   5.6423   6.2423
    .7240    .7240    .5295    .5295    .5295    .5295    .5295    .5295    .5295    .5295    .5295    .5295    .5295    .5295
    .5295    .5295
   0.0000   0.0000   0.0000   0.0000   0.0000    .1508    .3560    .3560    .3560    .3560    .3560    .3560    .3560    .3560
    .3560    .3560
 **** 7****
   1.7875   1.1065    .6309    .6162    .5576    .6747   1.2386   1.8386   2.4386   3.0386   3.6386   4.2386   4.8386   5.4386
   6.0386
```

.9485	.9485	.7240	.7240	.7240	.7240	.7240	.7240	.7240	.7240	.7240	.7240	.7240	.7240
.7240													
0.0000	0.0000	0.0000	0.0000	0.0000	.1508	.3560	.3560	.3560	.3560	.3560	.3560	.3560	.3560
.3560													
**** *****													
1.7975	1.5184	1.1065	1.0978	1.0633	1.1323	1.6961	2.2961	2.8961	3.4961	4.0961	4.6961	5.2961	5.8961
6.4961													
1.1430	1.1430	.9485	.9485	.9485	.9485	.9485	.9485	.9485	.9485	.9485	.9485	.9485	.9485
.9485													
0.0000	0.0000	0.0000	0.0000	0.0000	.1508	.3560	.3560	.3560	.3560	.3560	.3560	.3560	.3560
.3560													
**** *****													
1.7975	1.6529	1.5184	1.5150	1.5013	1.5286	2.0924	2.6924	3.2924	3.8924	4.4924	5.0924	5.6924	6.2924
1.2700	1.2065	1.1430	1.1430	1.1430	1.1430	1.1430	1.1430	1.1430	1.1430	1.1430	1.1430	1.1430	1.1430
0.0000	0.0000	0.0000	0.0000	0.0000	.1508	.3560	.3560	.3560	.3560	.3560	.3560	.3560	.3560

WAKE ELEMENTS
****

**** 1****

1.7875	2.2019	2.6162	3.8162	5.0162	6.2162
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 2****

1.7875	2.2019	2.6162	3.8162	5.0162	6.2162
.0830	.0830	.0830	.0830	.0830	.0830
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 3****

1.7875	2.2019	2.6162	3.8162	5.0162	6.2162
.2012	.2012	.2012	.2012	.2012	.2012
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 4****

1.7875	2.2019	2.6162	3.8162	5.0162	6.2162
.3195	.3195	.3195	.3195	.3195	.3195
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 5****

1.7875	2.2019	2.6162	3.8162	5.0162	6.2162
.4025	.4025	.4025	.4025	.4025	.4025
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 6****

1.7875	2.2019	2.6162	3.8162	5.0162	6.2162
.5295	.5295	.5295	.5295	.5295	.5295
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 7****

1.7875	2.2019	2.6162	3.8162	5.0162	6.2162
.7240	.7240	.7240	.7240	.7240	.7240
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 8****

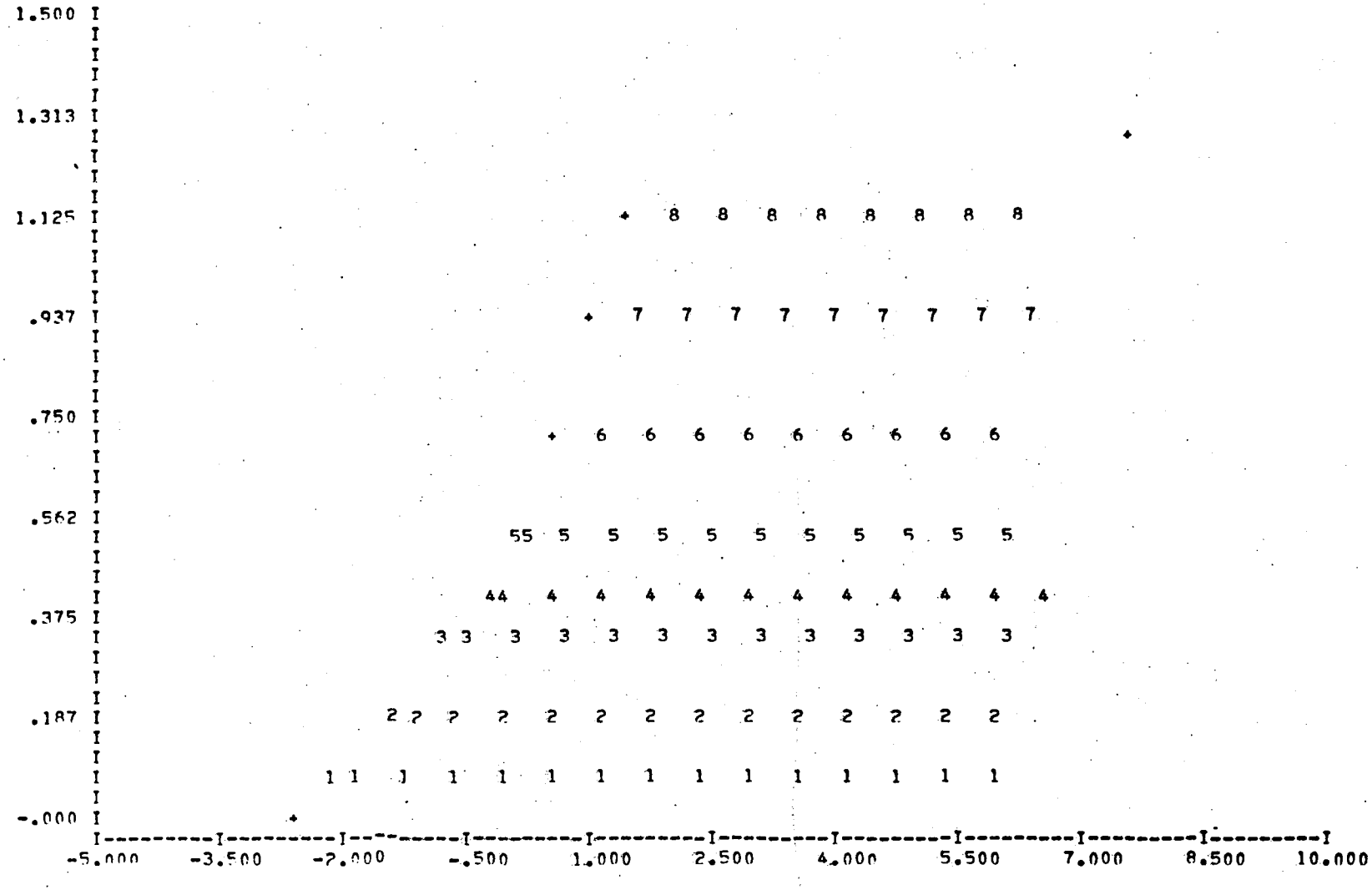
1.7875	2.2019	2.6162	3.8162	5.0162	6.2162
.9485	.9485	.9485	.9485	.9485	.9485
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 9****

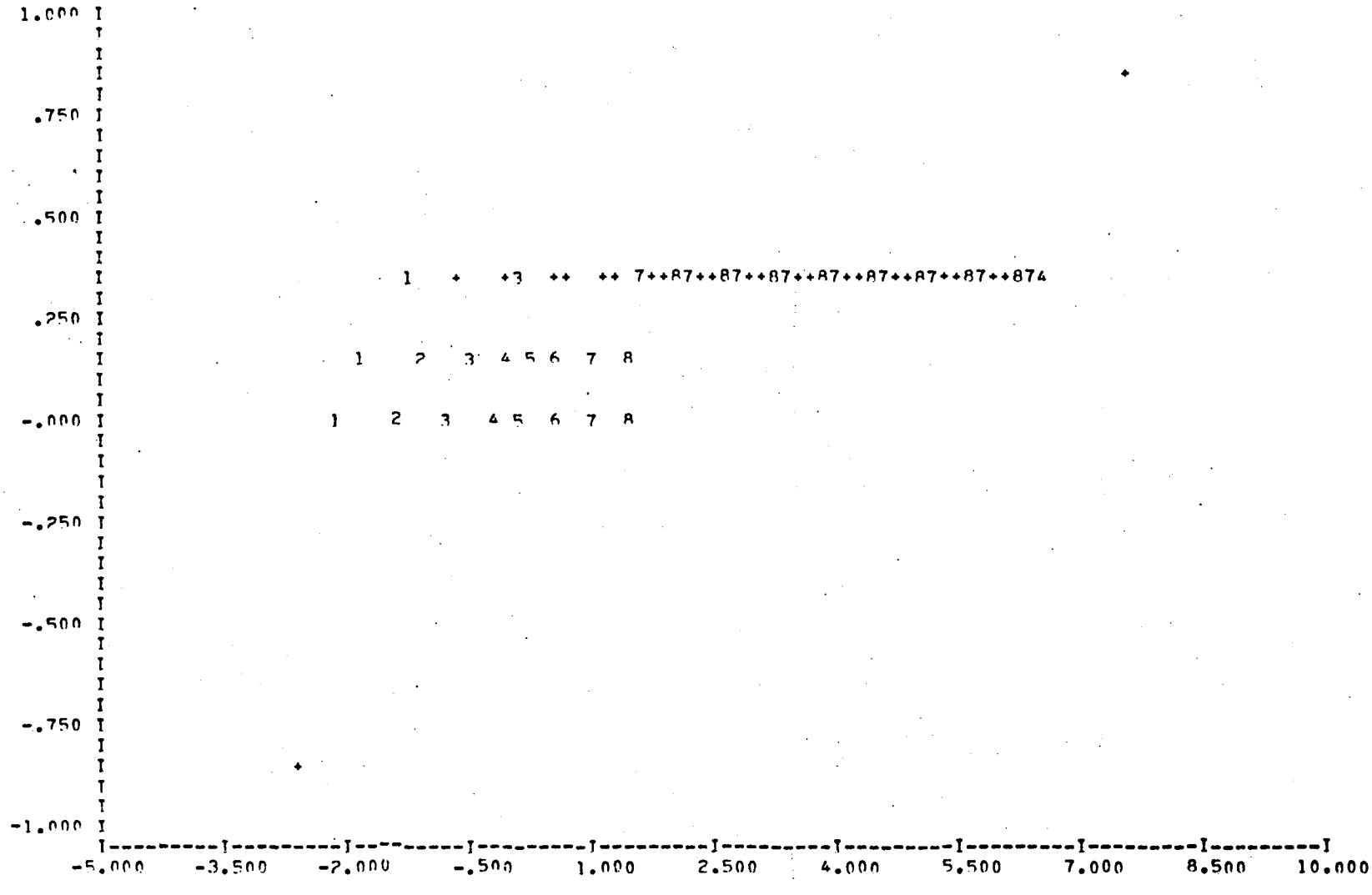
1.7875	2.2019	2.6162	3.8162	5.0162	6.2162
1.1430	1.1430	1.1430	1.1430	1.1430	1.1430
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****10****

1.7875	2.2019	2.6162	3.8162	5.0162	6.2162
1.2552	1.2552	1.2552	1.2552	1.2552	1.2552
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000


1.500
1.313
1.125
.937
.750
.562
.375
.187
-.000
-5.000
-3.500
-2.000
-.500
1.000
2.500
4.000
5.500
7.000
8.500
10.000

X VS Y


1.000
.750
.500
.250
-.000
-.250
-.500
-.750
-1.000
-5.000
-3.500
-2.000
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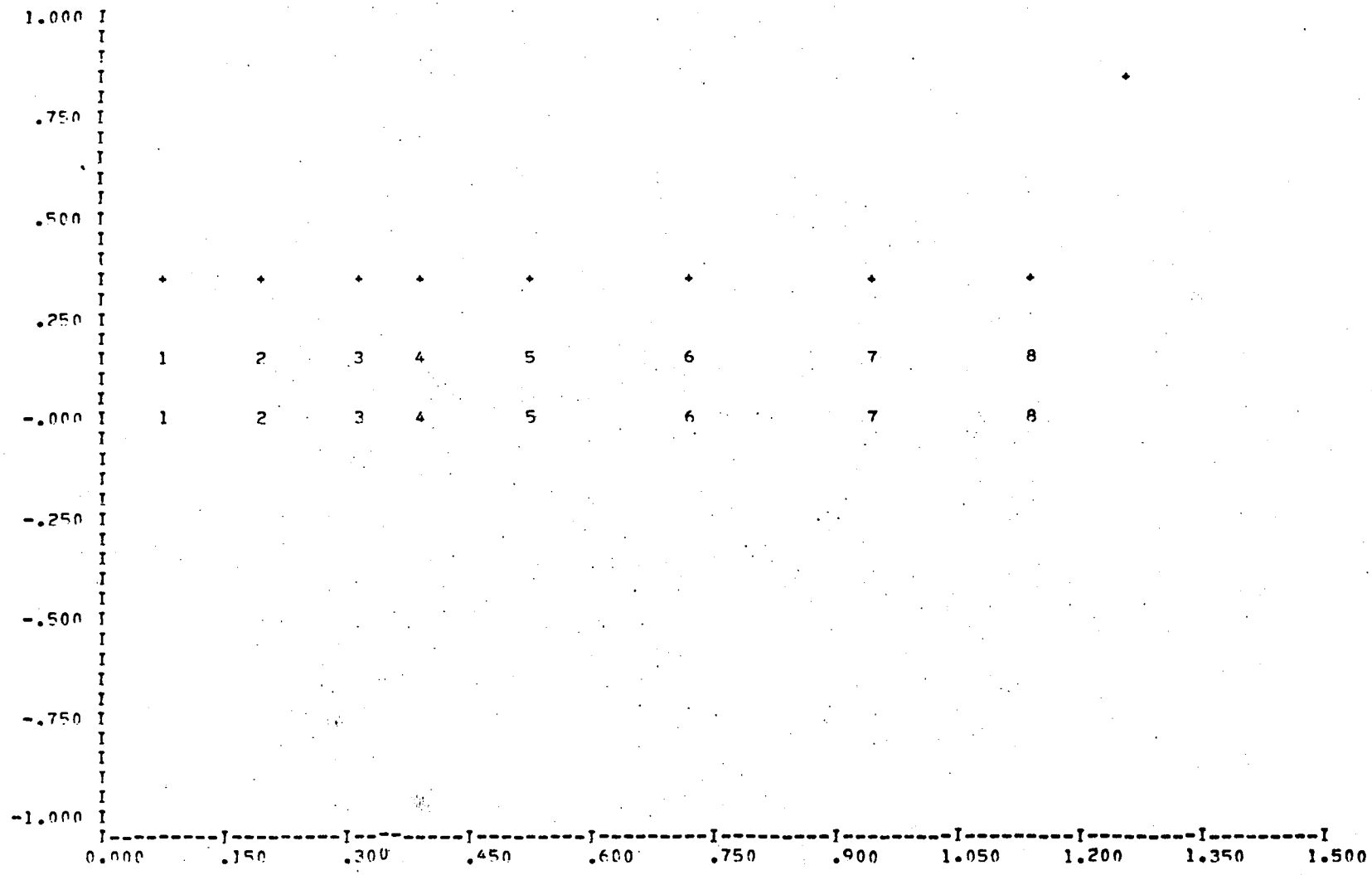
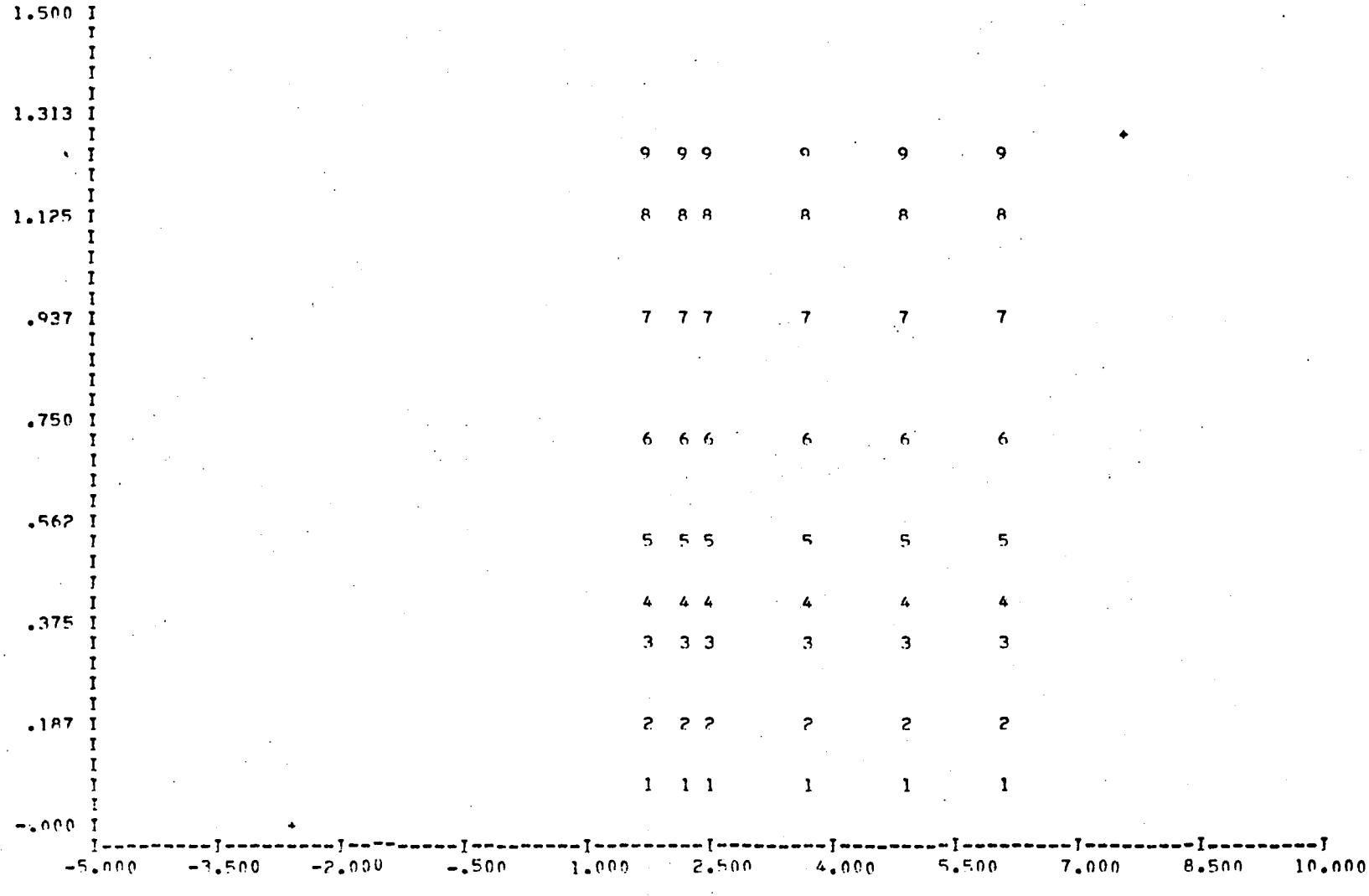
4.000
5.500
7.000
8.500
10.000

X VS Z


1.000
.750
.500
.250
-.000
-.250
-.500
-.750
-1.000
0.000
.150
.300
.450
.600
.750
.900
1.050
1.200
1.350
1.500
1 2 3 4 5 6 7 8
1 2 3 4 5 6 7 8

Y VS Z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.750
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.375
.187
-.000
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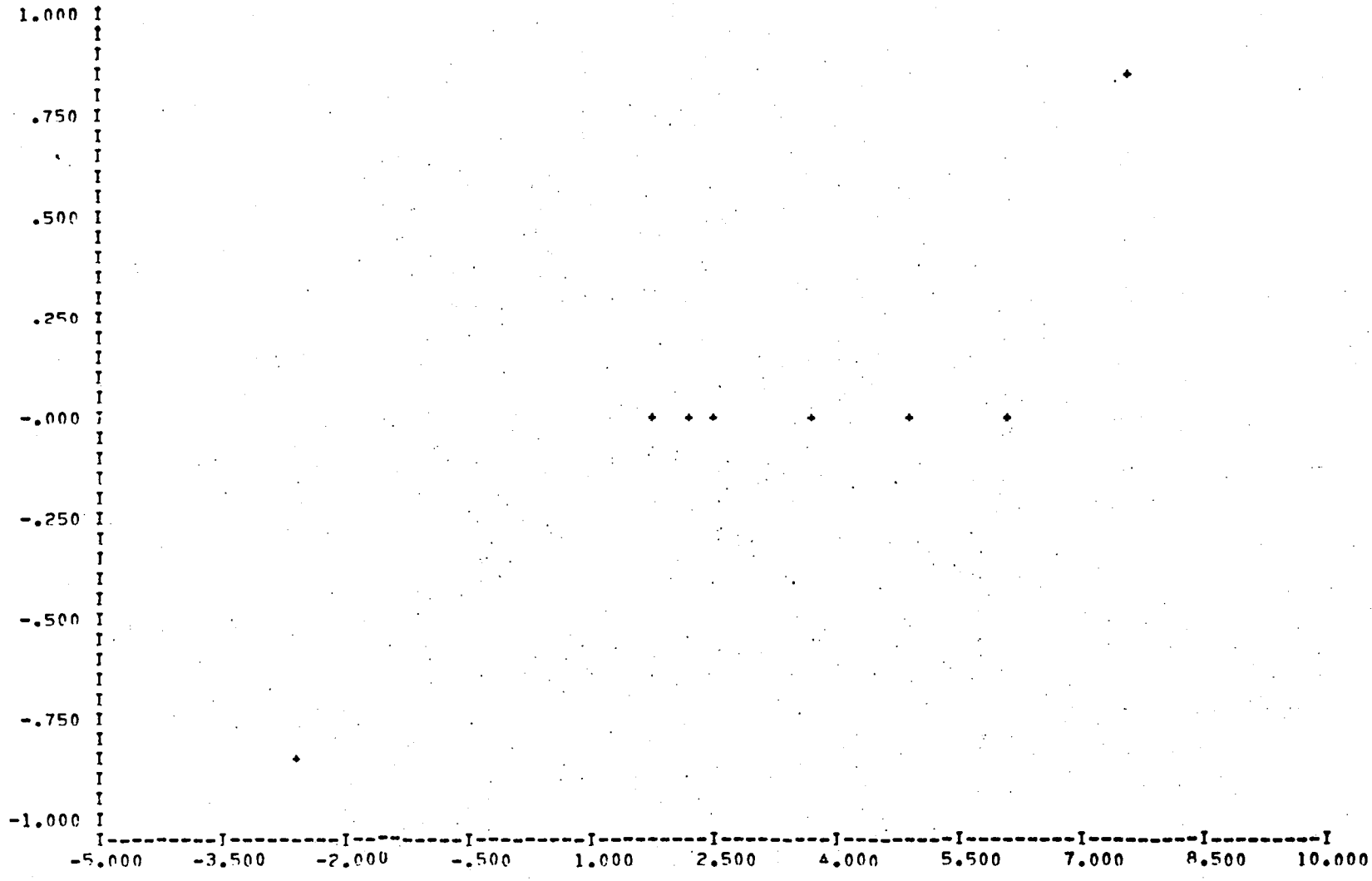
1.000
2.500
4.000
5.500
7.000
8.500
10.000

X VS Y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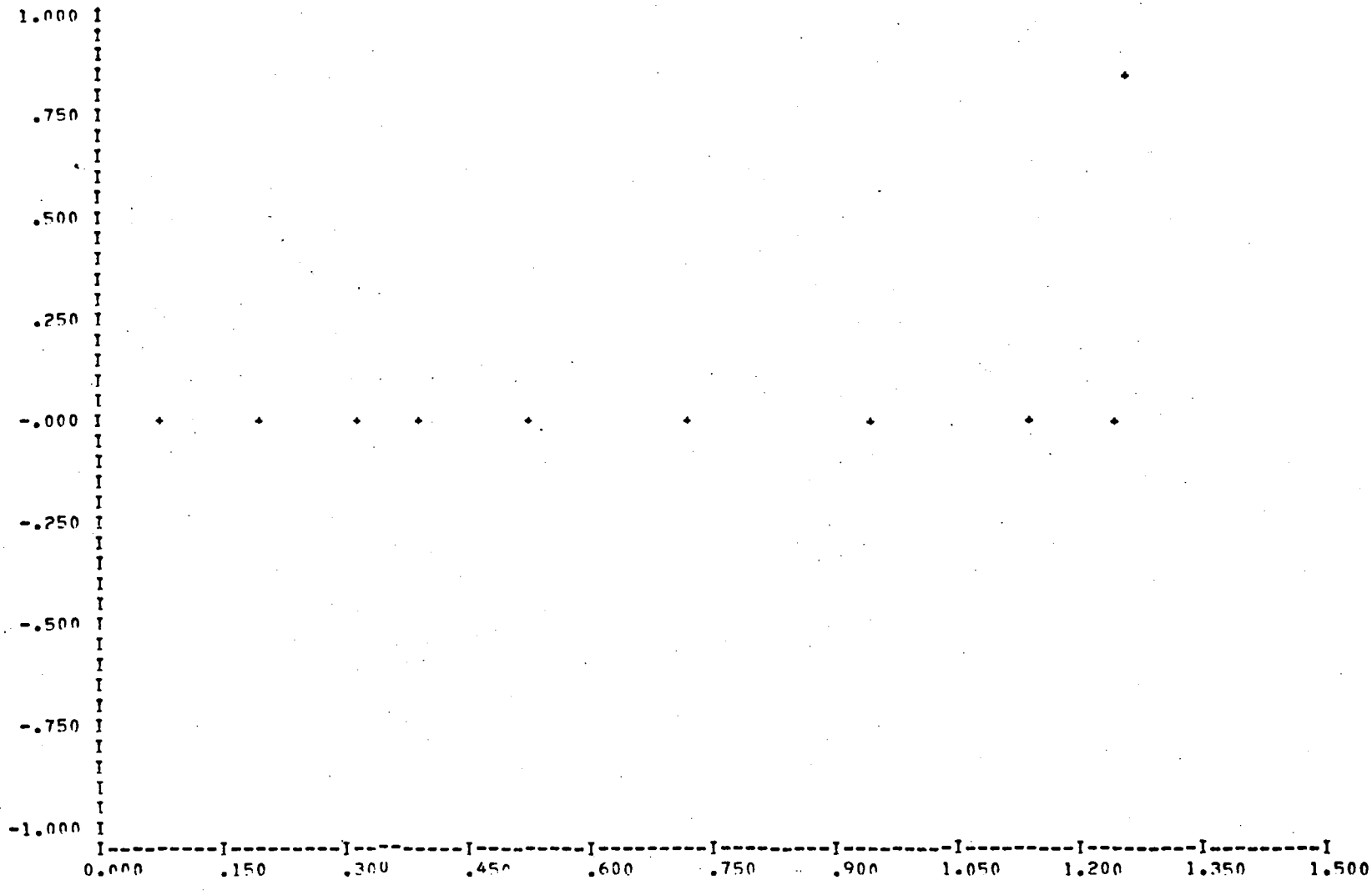
4.000
5.500
7.000
8.500
10.000

X VS Z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-.250
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-1.000
0.000
.150
.300
.450
.600
.750
.900
1.050
1.200
1.350
1.500

Y VS Z

WING VORTEX STRENGTHS
****

X/C	2Y/B	GAMAY
***	****	*****
.01704	.03026	2.59407
.14645	.03026	.55458
.37059	.03026	.48124
.62941	.03026	.41650
.85355	.03026	.20818
.98296	.03026	.06456
.01704	.10950	1.84774
.14645	.10950	.51271
.37059	.10950	.50379
.62941	.10950	.43369
.85355	.10950	.21543
.98296	.10950	.06394
.01704	.20743	2.16849
.14645	.20743	.61572
.37059	.20743	.56123
.62941	.20743	.39437
.85355	.20743	.20959
.98296	.20743	.05988
.01704	.28667	2.72216
.14645	.28667	.81409
.37059	.28667	.51791
.62941	.28667	.33941
.85355	.28667	.19500
.98296	.28667	.05518
.01704	.36269	3.36277
.14645	.36269	.70558
.37059	.36269	.44748
.62941	.36269	.30762
.85355	.36269	.18067
.98296	.36269	.05169
.01704	.48770	3.80582
.14645	.48770	.63311
.37059	.48770	.43098
.62941	.48770	.30090
.85355	.48770	.17102
.98296	.48770	.05169
.01704	.65846	5.18767
.14645	.65846	.62487
.37059	.65846	.46970
.62941	.65846	.30604
.85355	.65846	.17329
.98296	.65846	.05345

.01704	.82923	7.17912
.14645	.82923	.75970
.37059	.82923	.51900
.62941	.82923	.34963
.85355	.82923	.18928
.98296	.82923	.05787
.01704	.95424	11.06821
.14645	.95424	1.12482
.37059	.95424	.68775
.62941	.95424	.48266
.85355	.95424	.29289
.98296	.95424	.09640

LEADING-EDGE VORTICES STRENGTHS
****

2Y/B	CAPGAMA
****	*******
.03026	.49748
.10950	.31003
.20743	.29245
.29667	.28299
.36269	.29368
.49770	.27799
.65846	.25521
.82923	.17709
.95424	.07324

DELTA-CP DISTRIBUTION
****

X/C	2Y/B	DELTA-CP
***	****	********
.01254	.03026	2.62966
.10908	.03026	1.59500
.28306	.03026	.90802
.50000	.03026	1.02595
.71694	.03026	.70169
.89092	.03026	.38699
.98746	.03026	.16828
.01254	.10950	4.01913
.10908	.10950	.43372
.28306	.10950	.58924
.50000	.10950	1.05212
.71694	.10950	.81478
.89092	.10950	.55881
.98746	.10950	.30239
.01254	.20743	3.98947
.10908	.20743	.18237
.28306	.20743	.86410
.50000	.20743	1.51878
.71694	.20743	1.26026
.89092	.20743	.96383
.98746	.20743	.69370
.01254	.28667	4.93930
.10908	.28667	-.54324
.28306	.28667	.61739
.50000	.28667	1.33812
.71694	.28667	1.03098
.89092	.28667	1.00454
.98746	.28667	.71479
.01254	.36269	4.61817
.10908	.36269	2.05091
.28306	.36269	1.70809
.50000	.36269	1.48027
.71694	.36269	1.16088
.89092	.36269	.95976
.98746	.36269	.74452
.01254	.48770	2.83408
.10908	.48770	1.68652
.28306	.48770	1.21625
.50000	.48770	1.07119
.71694	.48770	1.01238
.89092	.48770	.78103
.98746	.48770	.66521
.01254	.65846	2.32425

.10908	.65846	1.77346
.28306	.65846	.94617
.50000	.65846	.74690
.71694	.65846	.72034
.89092	.65846	.48046
.98746	.65846	.32853
.01254	.82923	2.14580
.10908	.82923	1.85465
.28306	.82923	.88251
.50000	.82923	.57754
.71694	.82923	.33387
.89092	.82923	.18584
.98746	.82923	-.05753
.01254	.95424	1.99767
.10908	.95424	2.01973
.28306	.95424	.90859
.50000	.95424	.84597
.71694	.95424	.47257
.89092	.95424	.30501
.98746	.95424	-.10508

SECTIONAL PROPERTIES
****

I	CL	CM	CD	CT
*	**	**	**	**
1	.91402	.29392	.33268	0.00000
2	.82187	.06341	.29913	0.00000
3	1.09430	-.20372	.39829	0.00000
4	.92128	-.30765	.33532	0.00000
5	1.50465	-.48795	.54765	0.00000
6	1.13789	-.48842	.41416	0.00000
7	.89491	-.47787	.32572	0.00000
8	.71913	-.46625	.26174	0.00000
9	.83523	-.63475	.30400	0.00000

TOTAL LIFT COEFFICIENT= .97524
TOTAL PITCHING MOMENT COEFFICIENT= -.19059
TOTAL DRAG COEFFICIENT= .35496
TOTAL THRUST COEFFICIENT= 0.00000

SPANWISE PRESSURE AT CONSTANT X=, 0.00000

Y	2Y/B(LOCAL)	DELTA-CP
.03844	.08614	1.01798
.13906	.31166	1.03110
.26344	.59041	1.07920
.36406	.81593	.48499

SPANWISE PRESSURE AT CONSTANT X=, 1.00000

Y	2Y/B(LOCAL)	DELTA-CP
.03844	.04257	.50287
.13906	.15401	.72852
.26344	.29177	1.28738
.36406	.40321	1.17573
.46061	.51014	1.41442
.61937	.68598	1.08199
.83625	.92617	1.52318

Results for iterations 1 and 2 are omitted.

Initial Shape of the Free Sheet and Concentrated Core is shown in Iteration 3.

DOUBLE DELTA WING MODEL ONE (SCALING)
ALPHA(DEG.)=20.000 MACH NUMBER= 0.000 ITERATION NUMBER= 3

LEADING EDGE ELEMENTS
****

```
**** 1****
  1.7875  -1.8395  -2.3041  -2.3560  -2.3560  -2.3560  -2.3560  -2.3560  -2.3560  -2.3560  -2.3560  -2.3560  -1.8619  -.6482
   .5654   1.6013   2.6371   3.6730   4.7089
   .0830    .0830   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000    .0810   .1965
   .3119    .4327    .5090    .6076    .7062
  0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000    .0844   .2047
   .3250    .4277    .5304    .6331    .7358
**** 2****
  1.7875  -1.1771  -1.8395  -1.8856  -2.0692  -2.0294  -1.9898  -1.9485  -1.9056  -1.8619  -1.8619  -1.8619  -.6482   .5654
  1.6013   2.6371   3.6730   4.7089
   .2012    .2012    .0830    .0830    .0830    .0957    .1093    .1104    .0989    .0810    .0810    .0810    .1965   .3119
   .4105    .5090    .6076    .7062
  0.0000   0.0000   0.0000   0.0000   0.0000    .0291    .0586    .0833    .1032    .1206    .0844    .0844    .2047   .3250
   .4277    .5304    .6331    .7358
**** 3****
  1.7875   -.5147  -1.1771  -1.2148  -1.3649  -1.2274  -1.0903   -.9476   -.7993   -.6482   -.6482   -.6482   .5654  1.6013
  2.6371   3.6730   4.7089
   .3195    .3195    .2012    .2012    .2012    .2322    .2651    .2679    .2399    .1965    .1965    .1965   .3119   .4105
   .5090    .6076    .7062
  0.0000   0.0000   0.0000   0.0000   0.0000    .0707    .1421    .2021    .2503    .2926    .2047    .2047   .3250   .4277
   .5304    .6331    .7358
**** 4****
  1.7875   -.0502   -.5147   -.5439   -.6605   -.4253   -.1908    .0532    .3069    .5654    .5654    .5654  1.6013  2.6371
  3.6730   4.7089
   .4025    .4025    .3195    .3195    .3195    .3688    .4210    .4254    .3809    .3119    .3119    .3119   .4105   .5090
   .6076    .7062
  0.0000   0.0000   0.0000   0.0000   0.0000    .1123    .2257    .3209    .3974    .4646    .3250    .3250   .4277   .5304
   .6331    .7358
**** 5****
  1.7875    .2190   -.0502   -.0735   -.0735   -.0735   -.0735   -.0735   -.0735   -.0735   -.0735   -.0735   .4343  1.5858
  2.9156   4.0672   4.5324
   .5295    .5295    .4025    .4025    .4025    .4025    .4025    .4025    .4025    .4025    .4025    .4025   .5227   .7146
   .9362   1.1281   1.2057
  0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   .3101   .4239
   .5554    .6692    .7152
**** 6****
  1.7875    .6309    .2190    .1990    .1196    .1600    .2226    .2967    .3682    .4343    .4343    .4343  1.5858  2.9156
  4.0672   4.5324
   .7240    .7240    .5295    .5295    .5295    .5795    .5976    .5881    .5600    .5227    .5227    .5227   .7146   .9362
  1.1281   1.2057
  0.0000   0.0000   0.0000   0.0000   0.0000    .1309    .2052    .2468    .2889    .3398    .3101    .3101   .4239   .5554
   .6692    .7152
```

**** 7****

1.7875	1.1065	.6309	.6162	.5576	.6896	.8941	1.1365	1.3699	1.5858	1.5858	1.5858	2.9156	4.0672
4.5324													
.9485	.9485	.7240	.7240	.7240	.7923	.8171	.8041	.7657	.7146	.7146	.7146	.9362	1.1281
1.2057													
0.0000	0.0000	0.0000	0.0000	0.0000	.1790	.2806	.3374	.3949	.4646	.4239	.4239	.5554	.6692
.7152													

**** 8****

1.7875	1.5184	1.1065	1.0978	1.0633	1.3010	1.6695	2.1061	2.5267	2.9156	2.9156	2.9156	4.0672	4.5324
1.1430	1.1430	.9485	.9485	.9485	1.0380	1.0705	1.0534	1.0031	.9362	.9362	.9362	1.1281	1.2057
0.0000	0.0000	0.0000	0.0000	0.0000	.2346	.3676	.4420	.5174	.6087	.5554	.5554	.6692	.7152

**** 9****

1.7875	1.6529	1.5184	1.5150	1.5013	1.8306	2.3410	2.9458	3.5284	4.0672	4.0672	4.0672	4.5324
1.2700	1.2065	1.1430	1.1430	1.1430	1.2508	1.2900	1.2694	1.2088	1.1281	1.1281	1.1281	1.2057
0.0000	0.0000	0.0000	0.0000	0.0000	.2826	.4429	.5326	.6235	.7335	.6692	.6692	.7152

WAKE ELEMENTS
****

**** 1****

1.7875	2.2019	2.6162	3.8162	5.0162	6.2162
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

**** 2****

1.7875	2.2019	2.6141	3.8078	4.9993	6.1897
.0830	.0830	.1235	.2391	.3605	.4650
0.0000	0.0000	.0117	.0502	.1250	.2356

**** 3****

1.7875	2.2019	2.6063	3.7711	4.9219	6.0373
.2012	.2012	.2906	.5646	.7651	1.1722
0.0000	0.0000	.0117	.1015	.3761	.5500

**** 4****

1.7875	2.2019	2.6005	3.7413	4.8315	6.0231
.3195	.3195	.4325	.7225	1.0516	1.1404
0.0000	0.0000	-.0024	.2310	.6093	.7203

**** 5****

1.7875	2.2019	2.6009	3.7761	4.9552	6.1166
.4025	.4025	.5009	.7074	.8537	1.0986
0.0000	0.0000	-.0524	.0756	.2436	.4206

**** 6****

1.7875	2.2019	2.5932	3.7666	4.9363	6.1004
.5295	.5295	.6635	.9087	1.1473	1.3377
0.0000	0.0000	-.0248	.0294	.1514	.3717

**** 7****

1.7875	2.2019	2.5852	3.7010	4.8541	5.9960
.7240	.7240	.8793	.7160	.9615	1.1927
0.0000	0.0000	.0243	.4347	.6583	.9456

**** 8****

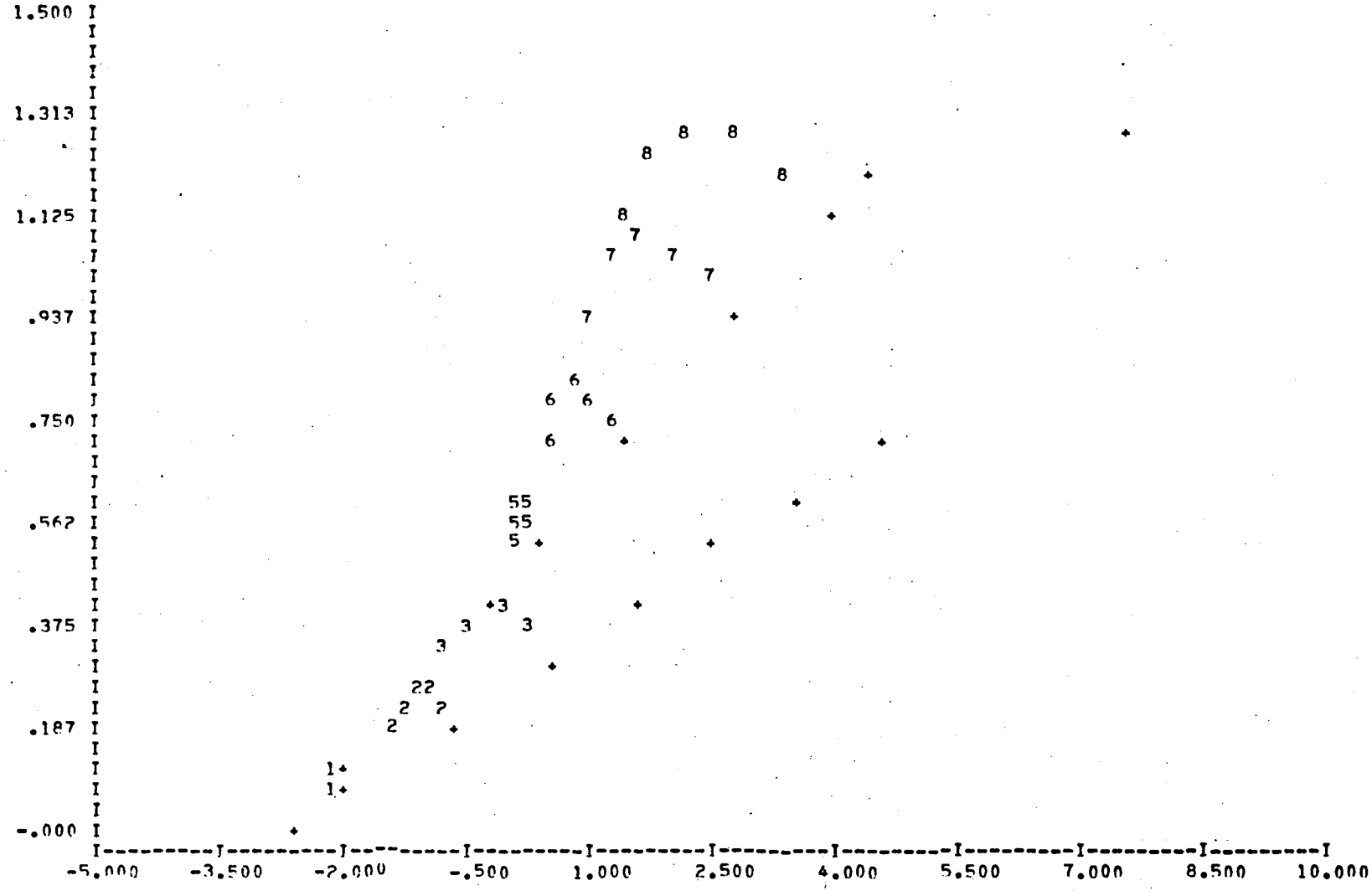
1.7875	2.2019	2.6034	3.7524	4.9057	6.0171
.9485	.9485	.8561	1.1356	1.3968	1.5875
0.0000	0.0000	.0435	.2479	.4518	.8623

**** 9****

1.7875	2.2019	2.6012	3.7681	4.9312	5.9790
1.1430	1.1430	1.0777	1.2857	1.4333	.9515
0.0000	0.0000	.0889	.2765	.5321	.8637

****10****

1.7875	2.2019	2.5868	3.7007	4.8251	5.9527
1.2552	1.2552	1.3265	1.5024	1.5875	1.5875
0.0000	0.0000	.1356	.5461	.9565	1.3669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-3.500
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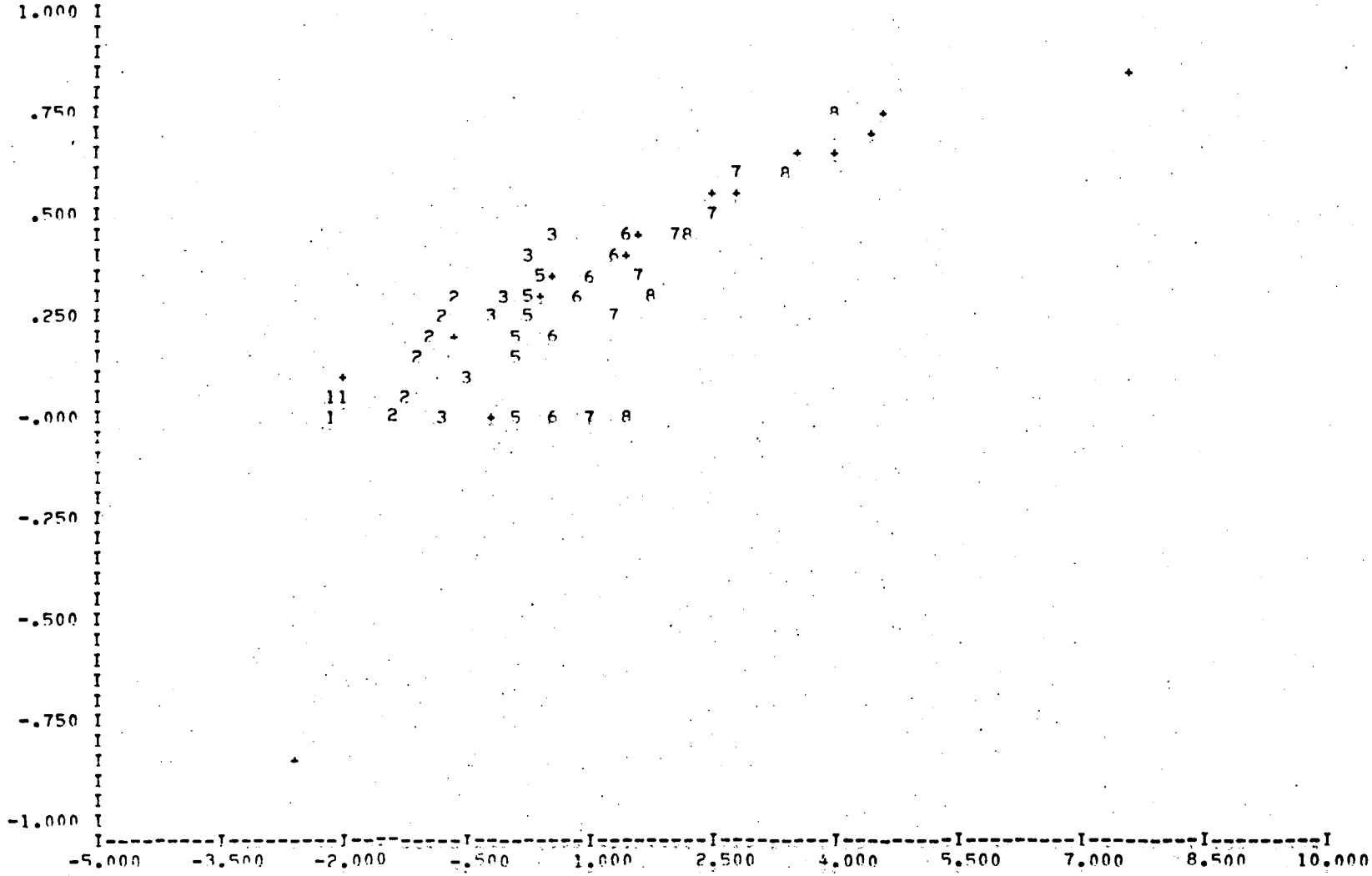
7.000
8.500
10.000

X VS Y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7.000
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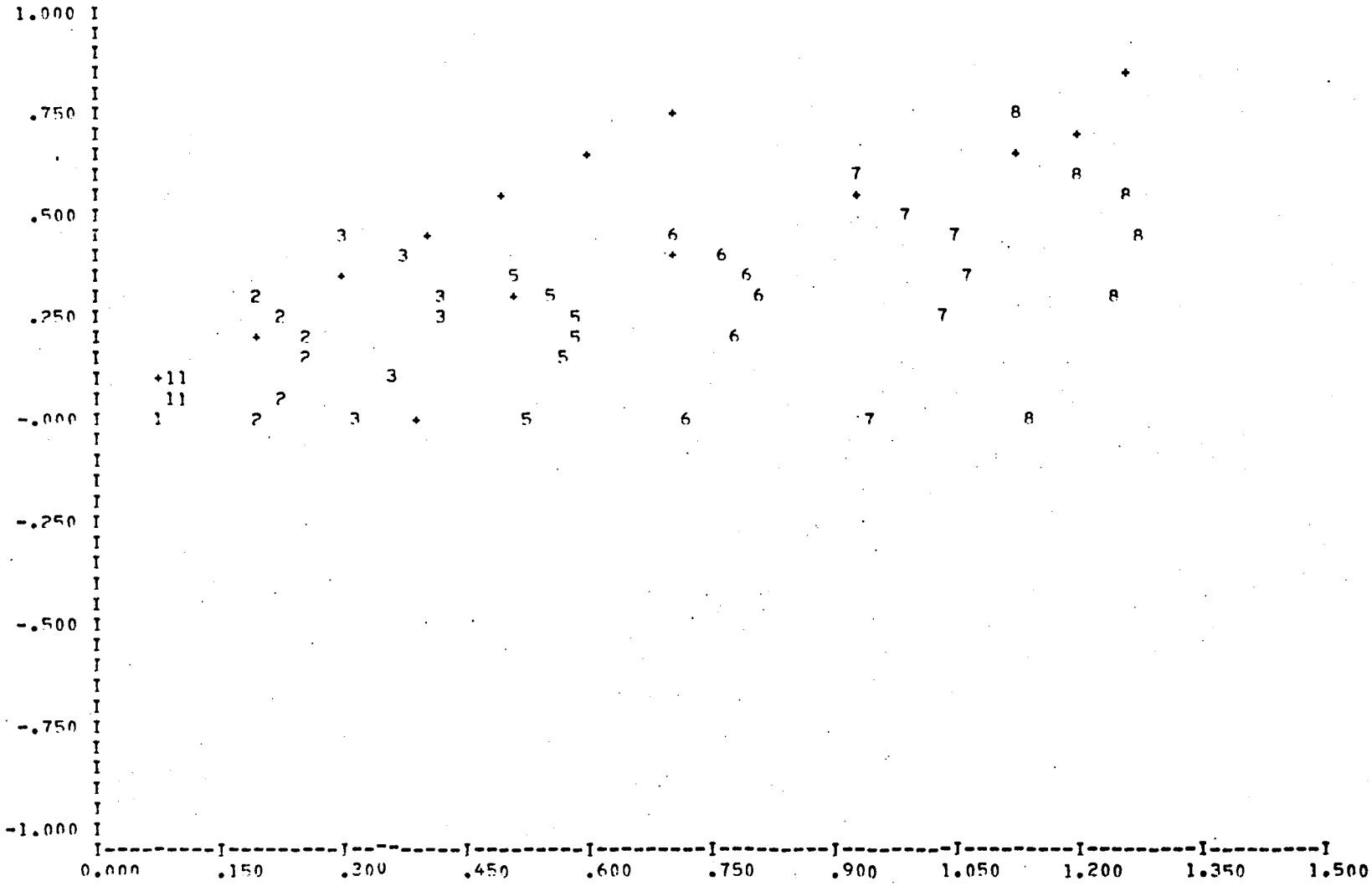
10.000

X VS Z


1.000
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.500
.250
-.000
-.250
-.500
-.750
-1.000
0.000
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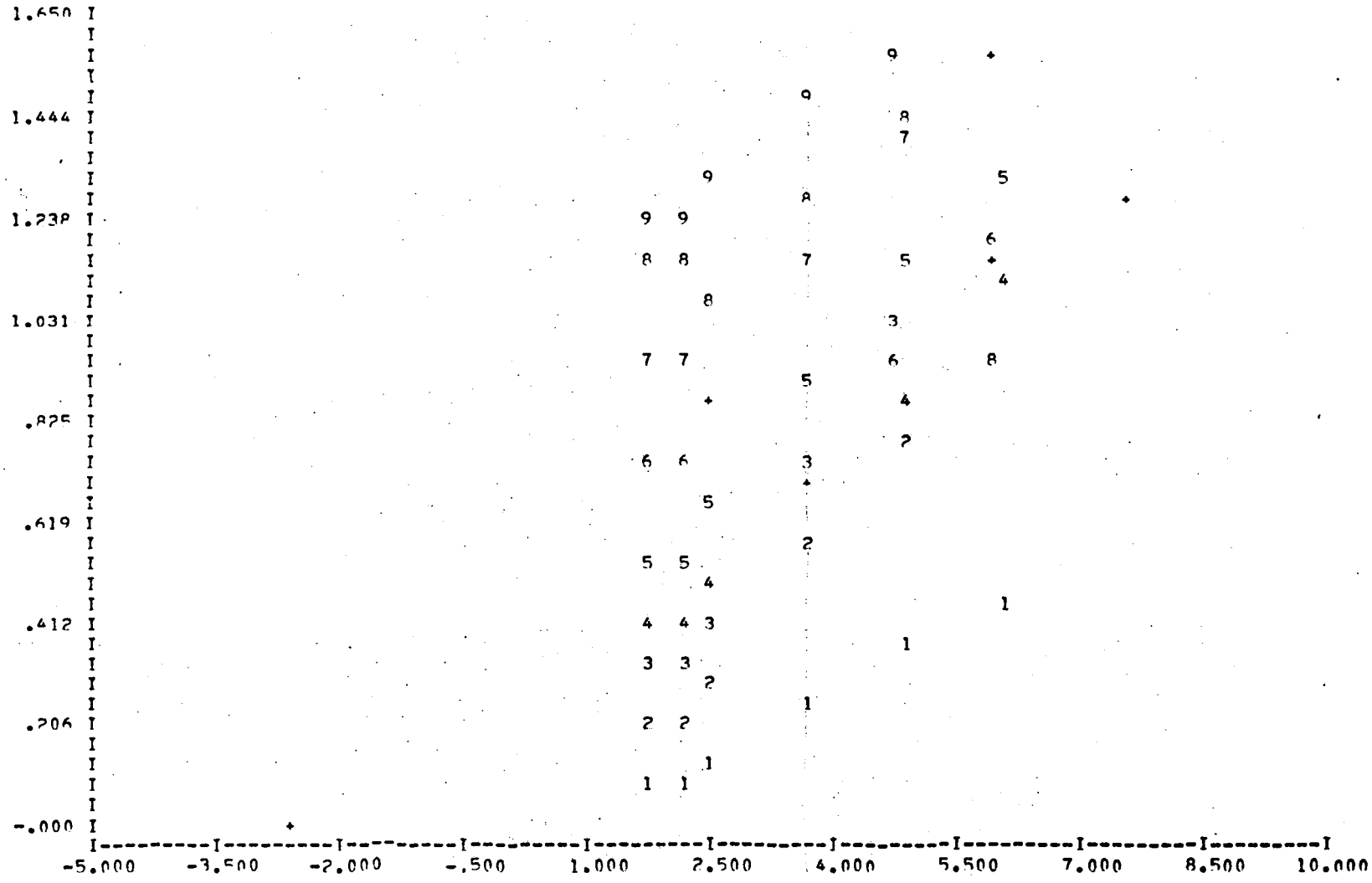
.300
.450
.600
.750
.900
1.050
1.200
1.350
1.500

Y VS Z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.412
.206
-.000
-5.000
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-2.000
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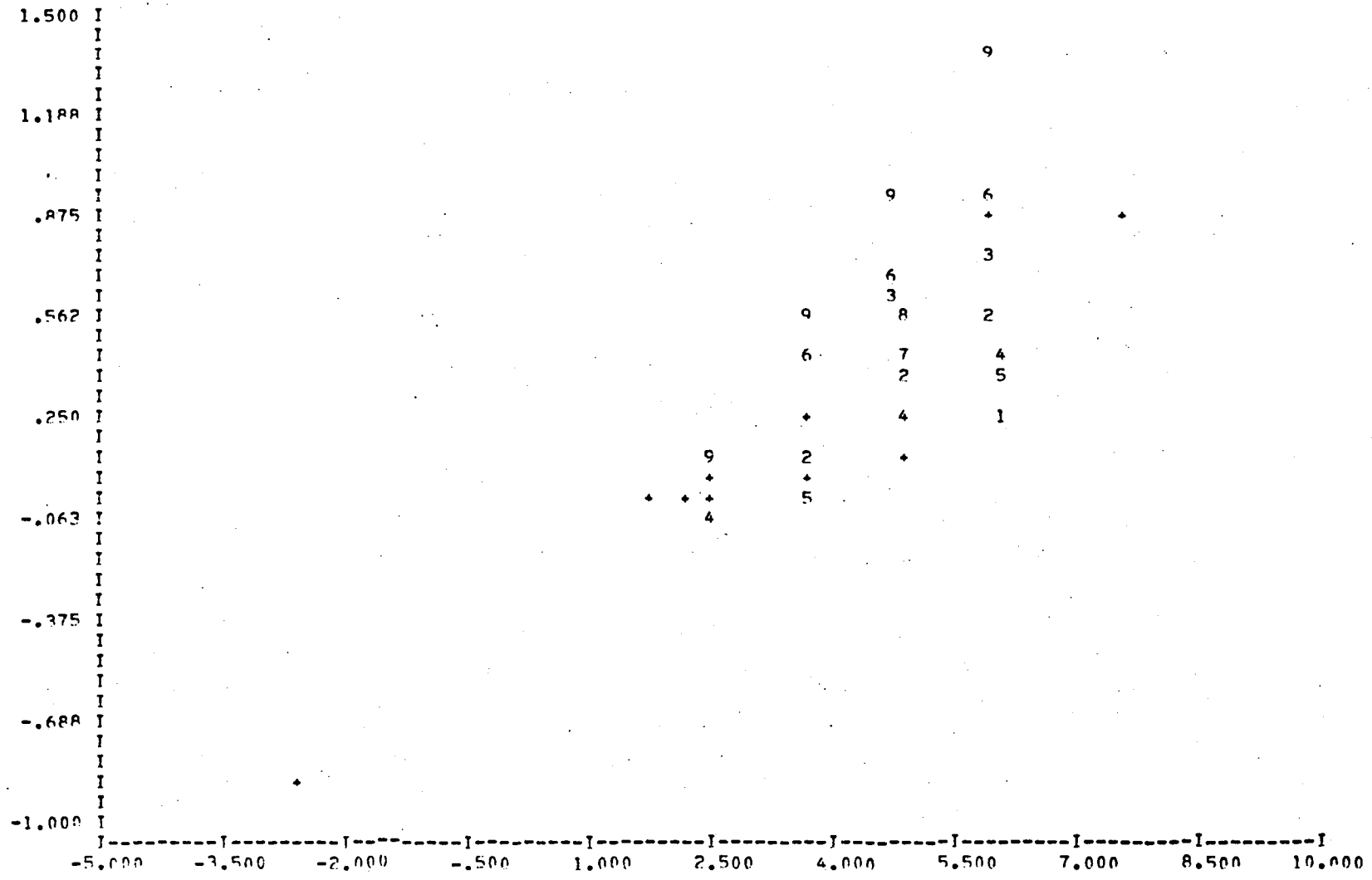
7.000
8.500
10.000

X VS Y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.562
.250
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-.375
-.688
-1.000
-5.000
-3.500
-2.000
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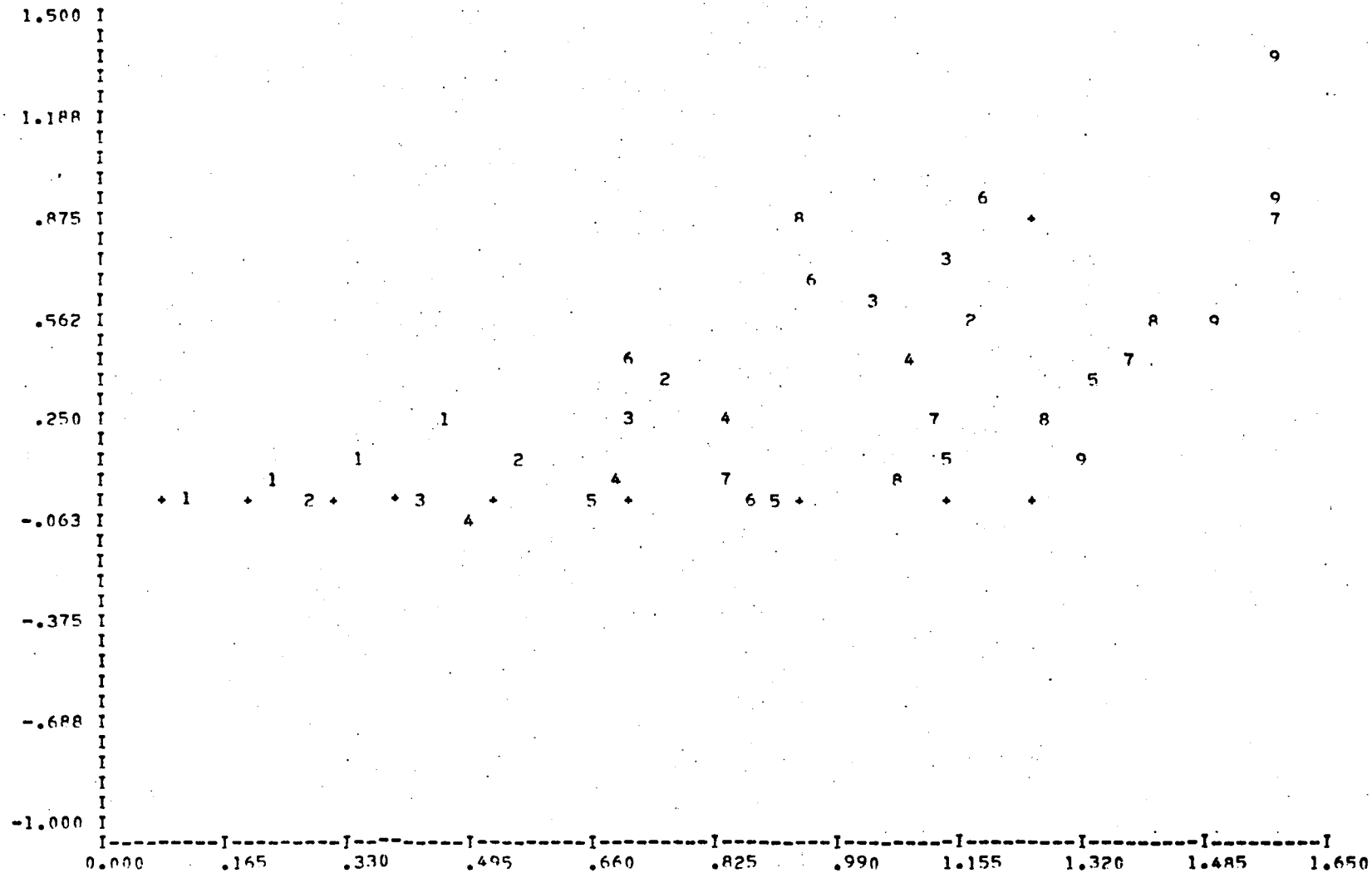
7.000
8.500
10.000

X VS Y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.562
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-.688
-1.000
0.000
.165
.330
.495
.660
.825
.990
1.155
1.320
1.485
1.650

Y VS Z

WING VORTEX STRENGTHS
****

X/C	2Y/B	GAMAY
***	****	*****
.01704	.03026	1.16655
.14645	.03026	.32423
.37059	.03026	.35653
.62941	.03026	.37494
.85355	.03026	.20965
.98296	.03026	.07753
.01704	.10950	1.13968
.14645	.10950	.30904
.37059	.10950	.37315
.62941	.10950	.38205
.85355	.10950	.21182
.98296	.10950	.07365
.01704	.20743	1.53600
.14645	.20743	.39808
.37059	.20743	.45155
.62941	.20743	.31617
.85355	.20743	.18866
.98296	.20743	.05938
.01704	.28667	1.84416
.14645	.28667	.69975
.37059	.28667	.39469
.62941	.28667	.24825
.85355	.28667	.15706
.98296	.28667	.04485
.01704	.36269	3.02992
.14645	.36269	.50711
.37059	.36269	.31690
.62941	.36269	.20740
.85355	.36269	.12733
.98296	.36269	.03317
.01704	.48770	3.11242
.14645	.48770	.48345
.37059	.48770	.29683
.62941	.48770	.19492
.85355	.48770	.10038
.98296	.48770	.02459
.01704	.65846	4.27184
.14645	.65846	.49318
.37059	.65846	.35985
.62941	.65846	.21589
.85355	.65846	.10538
.98296	.65846	.02945

.01704	.82923	6.05306
.14645	.82923	.62411
.37059	.82923	.40234
.62941	.82923	.28362
.85355	.82923	.15541
.98296	.82923	.04680
.01704	.95424	9.67653
.14645	.95424	.97577
.37059	.95424	.59063
.62941	.95424	.41087
.85355	.95424	.24795
.98296	.95424	.08148

LEADING-EDGE VORTICES STRENGTHS
****

2Y/B	CAPGAMA
.03026	.21875
.10950	.19305
.20743	.20768
.28667	.19398
.36269	.27156
.48770	.22727
.65846	.21033
.82923	.14945
.95424	.06405

DELTA-CP DISTRIBUTION
****

X/C	2Y/B	DELTA-CP
***	****	********
.01254	.03026	.42971
.10908	.03026	1.07984
.28306	.03026	.83555
.50000	.03026	.75921
.71694	.03026	.73044
.89092	.03026	.34812
.98746	.03026	.25502
.01254	.10950	2.82852
.10908	.10950	.79703
.28306	.10950	.89401
.50000	.10950	.97205
.71694	.10950	.69293
.89092	.10950	.41906
.98746	.10950	.15674
.01254	.20743	1.72386
.10908	.20743	-.20992
.28306	.20743	1.03863
.50000	.20743	1.51741
.71694	.20743	1.08278
.89092	.20743	.67433
.98746	.20743	.35061
.01254	.28667	7.84027
.10908	.28667	3.16404
.28306	.28667	1.31392
.50000	.28667	.63009
.71694	.28667	.92996
.89092	.28667	.40483
.98746	.28667	.46578
.01254	.36269	8.45642
.10908	.36269	2.00334
.28306	.36269	1.38517
.50000	.36269	1.28571
.71694	.36269	.84964
.89092	.36269	.74458
.98746	.36269	.46956
.01254	.48770	1.32732
.10908	.48770	1.29937
.28306	.48770	1.08632
.50000	.48770	.95596
.71694	.48770	.88967
.89092	.48770	.70772
.98746	.48770	.60836
.01254	.65846	1.82502

.10908	.65846	1.28225
.28306	.65846	.76076
.50000	.65846	.64379
.71694	.65846	.66539
.89092	.65846	.48549
.98746	.65846	.39853
.01254	.82923	1.98294
.10908	.82923	1.63616
.28306	.82923	.76444
.50000	.82923	.41394
.71694	.82923	.30774
.89092	.82923	.15503
.98746	.82923	-.01195
.01254	.95424	1.37264
.10908	.95424	1.35038
.28306	.95424	.71465
.50000	.95424	.61365
.71694	.95424	.35538
.89092	.95424	.19341
.98746	.95424	-.12076

SECTIONAL PROPERTIES
****

I	CL	CM	CD	CT
*	**	**	**	**
1	.67747	.13352	.24658	0.00000
2	.80642	.09343	.29351	0.00000
3	.88140	-.20084	.32080	0.00000
4	1.41811	-.17073	.51615	0.00000
5	1.47580	-.39687	.53715	0.00000
6	.93169	-.41901	.33911	0.00000
7	.74344	-.40669	.27059	0.00000
8	.61894	-.40048	.22528	0.00000
9	.59439	-.45180	.21634	0.00000

TOTAL LIFT COEFFICIENT= .88929
TOTAL PITCHING MOMENT COEFFICIENT= -.16675
TOTAL DRAG COEFFICIENT= .32367
TOTAL THRUST COEFFICIENT= 0.00000

SPANWISE PRESSURE AT CONSTANT X=, 0.00000

Y	2Y/B(LOCAL)	DELTA-CP
.03844	.08614	.77365
.13906	.31166	.98856
.26344	.59041	1.25688
.36406	.81593	2.73492

SPANWISE PRESSURE AT CONSTANT X=, 1.00000

Y	2Y/B(LOCAL)	DELTA-CP
.03844	.04257	.59200
.13906	.15401	.61522
.26344	.29177	1.11678
.36406	.40321	.81418
.46061	.51014	1.20301
.61937	.68598	.97445
.83625	.92617	1.12313

Similar results for several iterations till " SFAC " value shows an increase (after fifth iteration) from previous value. (See summary sheet on next page)

The best solution is shown after summary sheet.

DOUBLE DELTA WING MODEL ONE (SCALING)

ALPHA(DEG.)=20.000 MACH NUMBER= 0.000

ITERATION	CL	CM	CD	CT	GMSUM	SFAC
*********	**	**	**	**	*****	****
0	.9752	-.1906	.3550	0.0000	1.9627	
1	.8762	-.1590	.3189	0.0000	1.8095	
2	.9412	-.2111	.3426	0.0000	1.7998	
3	.8893	-.1667	.3237	0.0000	1.5174	.4826
4	.8734	-.1539	.3179	0.0000	1.5110	.3843
5	.8668	-.1506	.3155	0.0000	1.5034	.3292
6	.8497	-.1439	.3093	0.0000	1.4930	.4383

DOUBLE DELTA WING MODEL ONE (SCALING)
ALPHA(DEG.)=20.000 MACH NUMBER= 0.000 ITERATION NUMBER= 5

LEADING EDGE ELEMENTS
****

**** 1****

1.7875	-1.8395	-2.3041	-2.3560	-2.3560	-2.3560	-2.3560	-2.3560	-2.3560	-2.3560	-2.3560	-1.8619	-.6478	
.5663	1.6024	2.6384	3.6744	4.7107									
.0830	.0830	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.0810	.1948
.3102	.4305	.5066	.6052	.7035									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.0844	.2020
.3177	.4183	.5201	.6212	.7195									

**** 2****

1.7875	-1.1771	-1.8395	-1.8856	-2.0692	-1.8944	-1.8379	-1.7827	-1.7262	-1.6650	-1.6650	-1.8619	-.6478	.5663
1.6024	2.6384	3.6744	4.7107										
.2012	.2012	.0830	.0830	.0830	.1147	.1270	.1283	.1174	.0810	.0810	.0810	.1948	.3102
.4305	.5066	.6052	.7035										
0.0000	0.0000	0.0000	0.0000	0.0000	.0201	.0501	.0819	.1129	.1356	.0994	.0844	.2020	.3177
.4183	.5201	.6212	.7195										

**** 3****

1.7875	-.5147	-1.1771	-1.2148	-1.3649	-1.2363	-1.0991	-.9651	-.8282	-.6796	-.6796	-.6478	.5663	1.6024
2.6384	3.6744	4.7107											
.3195	.3195	.2012	.2012	.2012	.2784	.3082	.3113	.2848	.1948	.1948	.1948	.3102	.4305
.5066	.6052	.7035											
0.0000	0.0000	0.0000	0.0000	0.0000	.0487	.1214	.1988	.2740	.3290	.2411	.2020	.3177	.4183
.5201	.6212	.7195											

**** 4****

1.7875	-.0502	-.5147	-.5439	-.6605	-.4341	-.1953	.0248	.2594	.5138	.5138	.5663	1.6024	2.6384
3.6744	4.7107												
.4025	.4025	.3195	.3195	.3195	.4049	.4109	.3763	.2697	.1662	.1662	.3102	.4305	.5066
.6052	.7035												
0.0000	0.0000	0.0000	0.0000	0.0000	.1084	.2250	.3627	.4398	.4132	.2736	.3177	.4183	.5201
.6212	.7195												

**** 5****

1.7875	.2190	-.0502	-.0735	-.0735	-.0735	-.0735	-.0735	-.0735	-.0735	-.0735	-.0735	.4343	1.5861
2.9159	4.0677	4.5330											
.5295	.5295	.4025	.4025	.4025	.4025	.4025	.4025	.4025	.4025	.4025	.4025	.5227	.7134
.9347	1.1263	1.2037											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.3101	.4234
.5547	.6667	.7126											

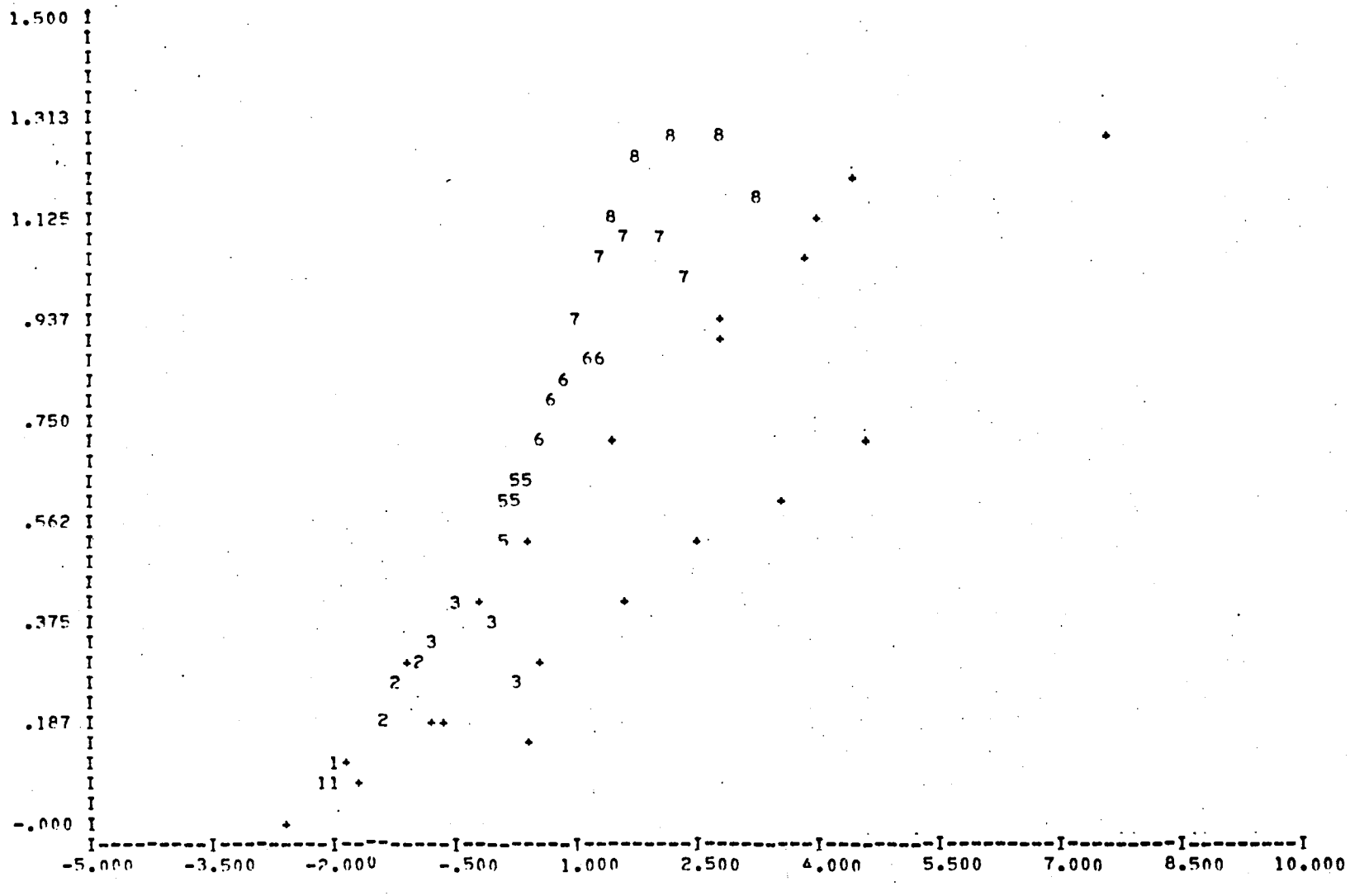
**** 6****

1.7875	.6309	.2190	.1990	.1196	.2046	.2820	.3499	.4137	.4771	.4771	.4343	1.5861	2.9159
4.0677	4.5330												
.7240	.7240	.5295	.5295	.5295	.5864	.6083	.6219	.6300	.5227	.5227	.5227	.7134	.9347
1.1263	1.2037												
0.0000	0.0000	0.0000	0.0000	0.0000	.1040	.1613	.2116	.2710	.3682	.3384	.3101	.4234	.5547
.6667	.7126												

```
**** 7****
  1.7875   1.1065    .6309    .6162    .5576    .7466    .9478   1.1638   1.3658   1.5624   1.5624   1.5861   2.9159   4.0677
  4.5330
   .9485    .9485    .7240    .7240    .7240    .8003    .8434    .8704    .8653    .7134    .7134    .7134    .9347   1.1263
  1.2037
  0.0000   0.0000   0.0000   0.0000   0.0000    .1121    .2142    .3357    .4717    .6037    .5630    .4234    .5547    .6667
   .7126
**** 8****
  1.7875   1.5184   1.1065   1.0978   1.0633   1.3456   1.6885   2.0748   2.4455   2.8063   2.8063   2.9159   4.0677   4.5330
  1.1430   1.1430    .9485    .9485    .9485   1.0346   1.0854   1.0958   1.0306    .9173    .9173    .9347   1.1263   1.2037
  0.0000   0.0000   0.0000   0.0000   0.0000    .1801    .3654    .5825    .7909    .9393    .8860    .5547    .6667    .7126
**** 9****
  1.7875   1.6529   1.5184   1.5150   1.5013   1.3688   2.3308   2.8611   3.3832   3.8917   3.8917   4.0677   4.5330
  1.2700   1.2065   1.1430   1.1430   1.1430   1.2289   1.2893   1.2814   1.1556   1.0328   1.0328   1.1263   1.2037
  0.0000   0.0000   0.0000   0.0000   0.0000    .2398    .5055    .8105   1.0615   1.2492   1.1849    .6667    .7126
```

WAKE ELEMENTS
****

```
**** 1****
  1.7875   2.2019   2.6162   3.8162   5.0162   6.2162
  0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
  0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
**** 2****
  1.7875   2.2019   2.6140   3.8063   4.9954   6.1766
   .0830    .0830    .1196    .2465    .3945    .5419
  0.0000   0.0000    .0211    .0705    .1347    .2861
**** 3****
  1.7875   2.2019   2.6062   3.7531   4.9493   5.8826
   .2012    .2012    .2879    .6151   1.0335   1.4850
  0.0000   0.0000    .0264    .1586    .4103    .8208
**** 4****
  1.7875   2.2019   2.5935   3.6464   4.6577   5.8543
   .3195    .3195    .4490   1.0004   1.4991   1.5875
  0.0000   0.0000    .0387    .2046    .6150    .5977
**** 5****
  1.7875   2.2019   2.6025   3.7230   4.7922   5.8903
   .4025    .4025    .5080    .8579   1.3312   1.5875
  0.0000   0.0000   -.0038    .2454    .5152    .9256
**** 6****
  1.7875   2.2019   2.5878   3.7463   4.8560   5.9486
   .5295    .5295    .6792    .9638   1.3088   1.5875
  0.0000   0.0000    .0176    .1481    .4472    .8577
**** 7****
  1.7875   2.2019   2.5782   3.6990   4.7807   5.9084
   .7240    .7240    .8877   1.3054   1.5875   1.5875
  0.0000   0.0000    .0572   -.1207    .2897    .7001
**** 8****
  1.7875   2.2019   2.5767   3.6345   4.7208   5.8470
   .9485    .9485    .7774   1.2294   1.5320   1.5875
  0.0000   0.0000    .0436    .3854    .7958   1.2063
**** 9****
  1.7875   2.2019   2.5886   3.7749   4.8287   5.9559
  1.1430   1.1430   1.0469   1.1577   1.5591   1.5875
  0.0000   0.0000    .1134    .2568    .6672   1.0776
****10****
  1.7875   2.2019   2.5813   3.6902   4.8176   5.9450
  1.2552   1.2552   1.3426   1.5474   1.5678   1.5469
  0.0000   0.0000    .1417    .5521    .9626   1.3730
```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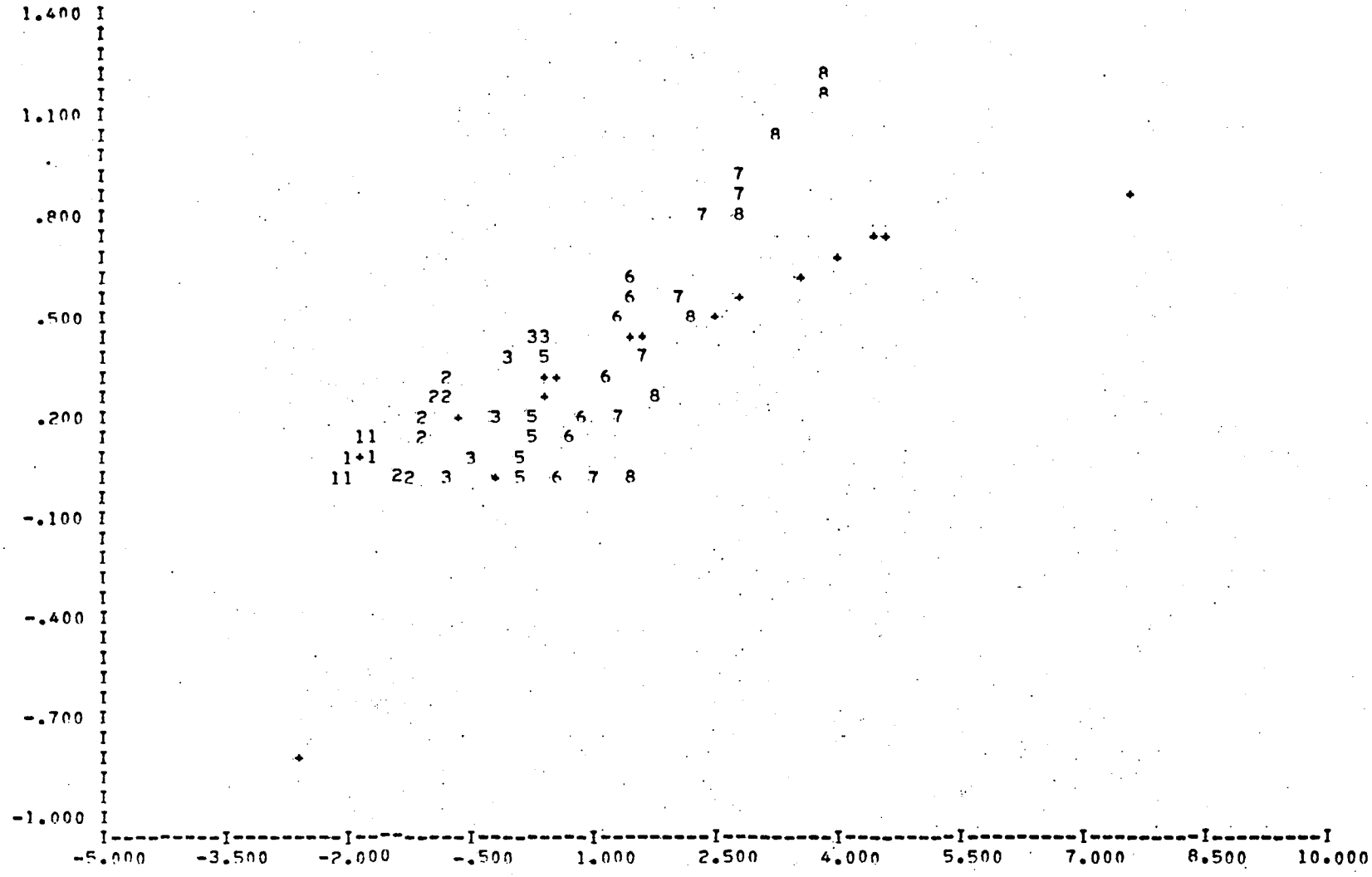
X VS Y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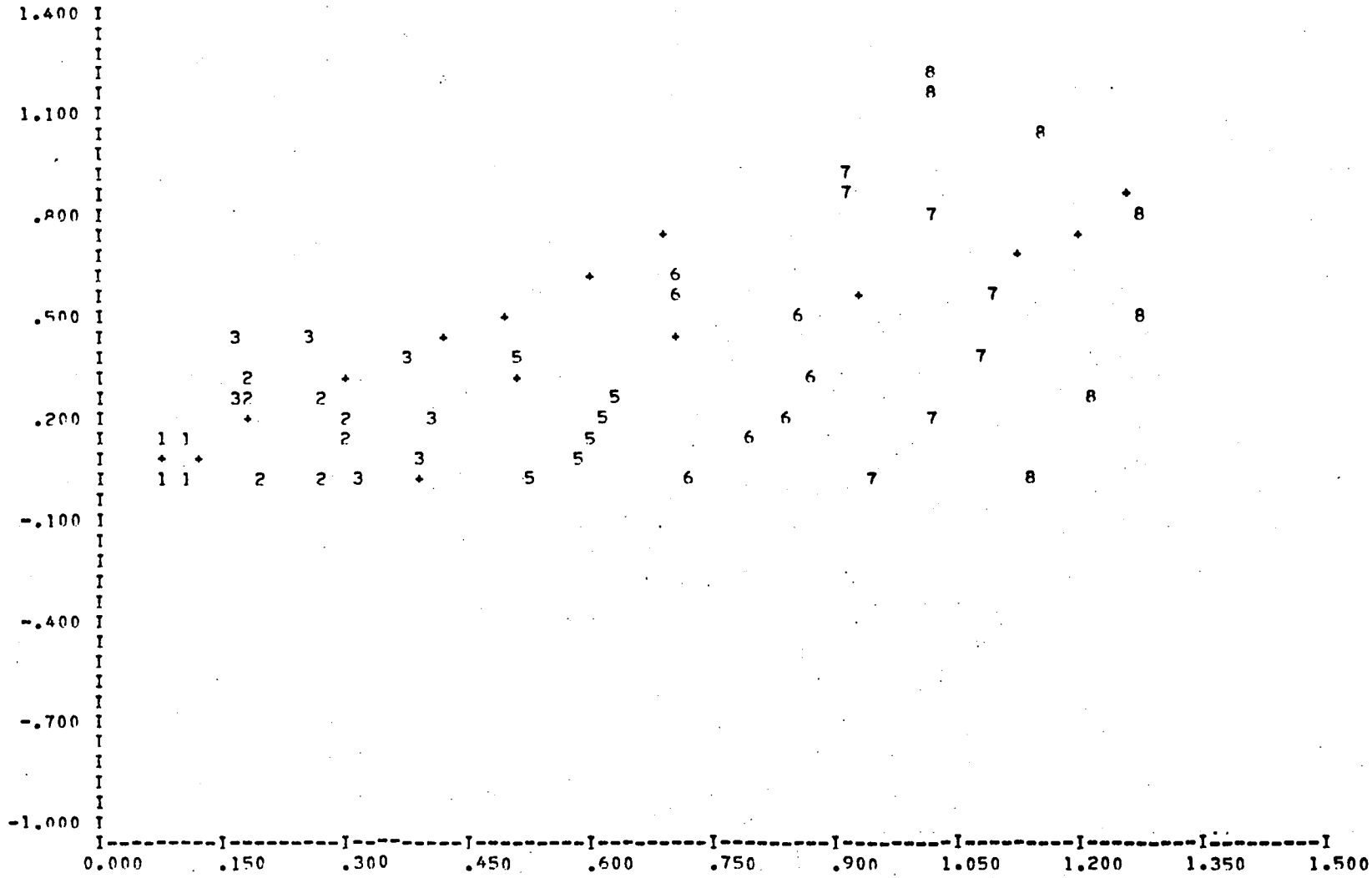
X VS 7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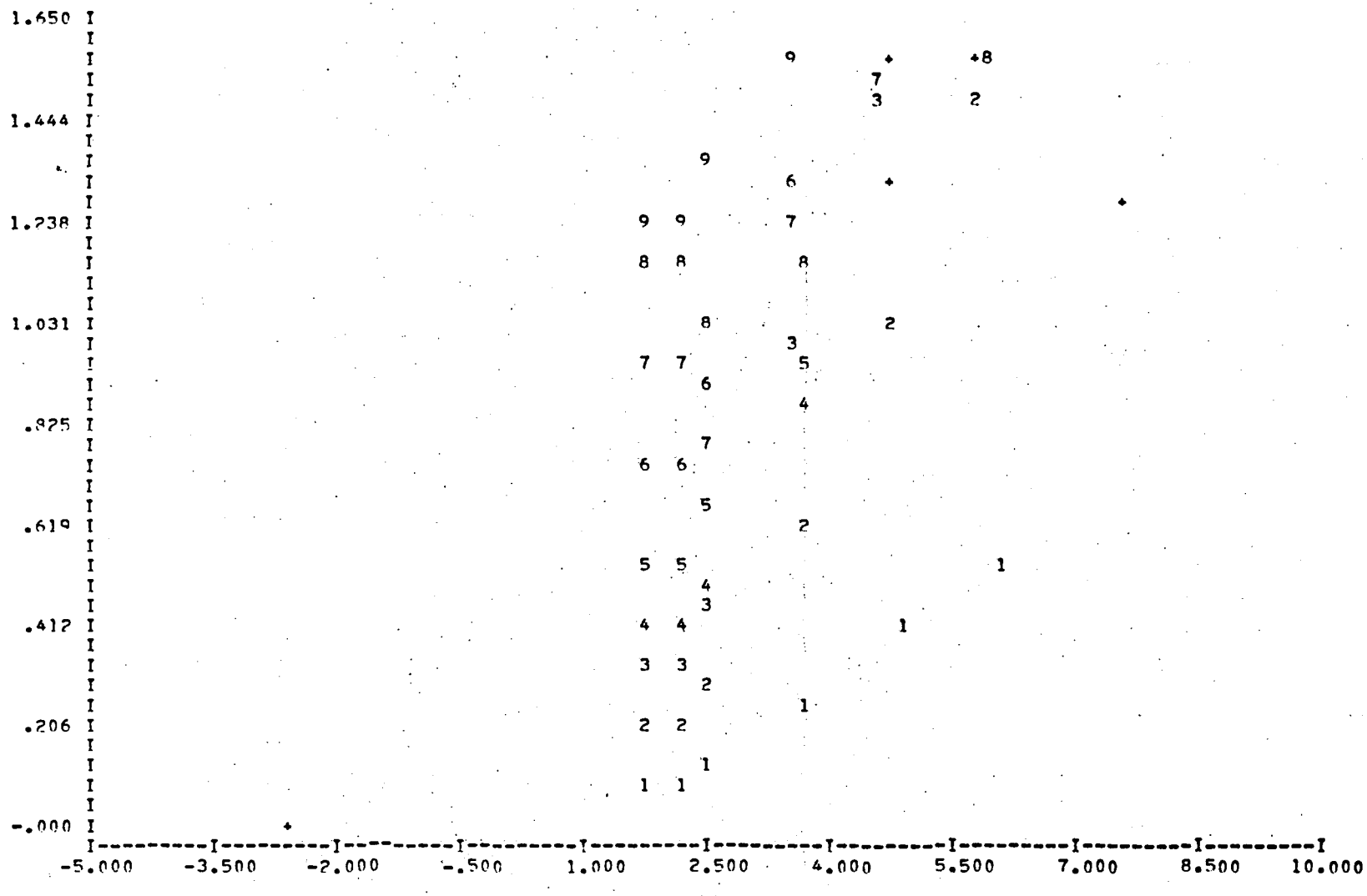
Y VS Z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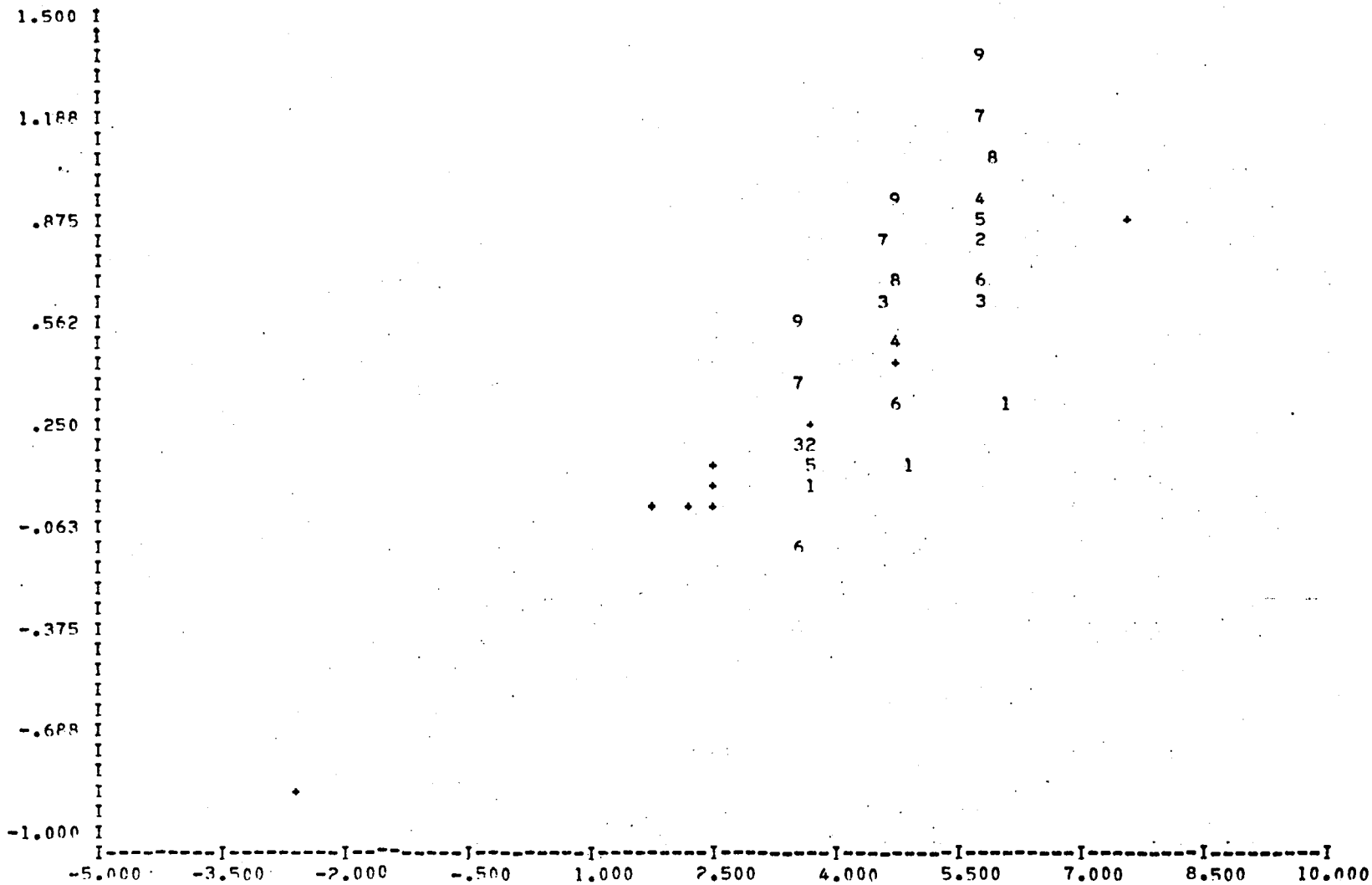
X VS Y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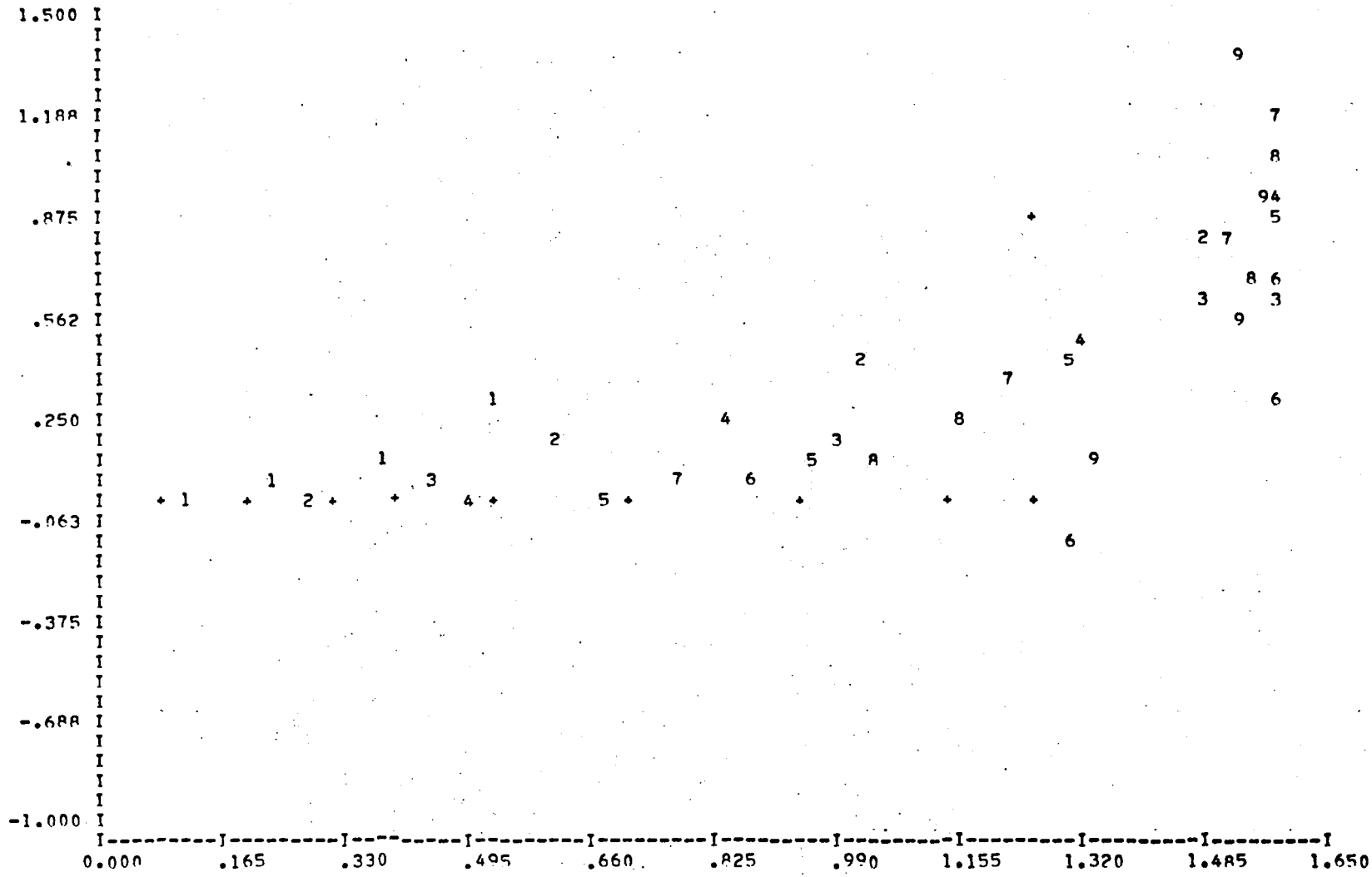
X VS Z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.165
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.660
.825
.990
1.155
1.320
1.485
1.650

Y VS Z

WING VORTEX STRENGTHS
****

X/C	2Y/B	GAMAY
***	****	*****
.01704	.03026	.97697
.14645	.03026	.38215
.37059	.03026	.35159
.62941	.03026	.35290
.85355	.03026	.20349
.98296	.03026	.07610
.01704	.10950	1.22977
.14645	.10950	.31044
.37059	.10950	.36876
.62941	.10950	.35601
.85355	.10950	.20574
.98296	.10950	.07252
.01704	.20743	1.57073
.14645	.20743	.39824
.37059	.20743	.43781
.62941	.20743	.29094
.85355	.20743	.18331
.98296	.20743	.05902
.01704	.28667	1.84832
.14645	.28667	.67881
.37059	.28667	.37479
.62941	.28667	.23291
.85355	.28667	.15310
.98296	.28667	.04507
.01704	.36269	2.89782
.14645	.36269	.50371
.37059	.36269	.29915
.62941	.36269	.19963
.85355	.36269	.12529
.98296	.36269	.03389
.01704	.48770	2.98843
.14645	.48770	.44502
.37059	.48770	.29755
.62941	.48770	.19545
.85355	.48770	.10403
.98296	.48770	.02691
.01704	.65846	4.09470
.14645	.65846	.45920
.37059	.65846	.34521
.62941	.65846	.22731
.85355	.65846	.11791
.98296	.65846	.03322

.01704	.82923	5.90207
.14645	.82923	.59899
.37059	.82923	.38384
.62941	.82923	.27781
.85355	.82923	.15767
.98296	.82923	.04829
.01704	.95424	9.58142
.14645	.95424	.96095
.37059	.95424	.57694
.62941	.95424	.39807
.85355	.95424	.23883
.98296	.95424	.07833

LEADING-EDGE VORTICES STRENGTHS
****

2Y/B	CAPGAMA
****	*******
.03026	.18657
.10950	.20608
.20743	.21167
.28667	.19413
.36269	.26172
.48770	.21847
.65846	.20201
.82923	.14585
.95424	.06343

DELTA-CP DISTRIBUTION
****

X/C	2Y/B	DELTA-CP
***	****	********
.01254	.03026	.90496
.10908	.03026	1.28204
.28306	.03026	.88498
.50000	.03026	.71102
.71694	.03026	.69318
.89092	.03026	.33870
.98746	.03026	.24903
.01254	.10950	2.68298
.10908	.10950	.92909
.28306	.10950	.96079
.50000	.10950	.92916
.71694	.10950	.64143
.89092	.10950	.41340
.98746	.10950	.14867
.01254	.20743	1.30621
.10908	.20743	-.11517
.28306	.20743	1.03939
.50000	.20743	1.42176
.71694	.20743	1.01397
.89092	.20743	.65418
.98746	.20743	.33857
.01254	.28667	7.24285
.10908	.28667	2.92956
.28306	.28667	1.19925
.50000	.28667	.57214
.71694	.28667	.88029
.89092	.28667	.40340
.98746	.28667	.45483
.01254	.36269	7.96349
.10908	.36269	1.84363
.28306	.36269	1.25312
.50000	.36269	1.19310
.71694	.36269	.01768
.89092	.36269	.72404
.98746	.36269	.46685
.01254	.48770	1.45271
.10908	.48770	1.28982
.28306	.48770	1.03077
.50000	.48770	.88973
.71694	.48770	.55536
.89092	.48770	.68398
.98746	.48770	.59195
.01254	.65846	1.89426

.10908	.65846	1.23161
.28306	.65846	.75092
.50000	.65846	.61742
.71694	.65846	.67132
.89092	.65846	.47015
.98746	.65846	.38511
.01254	.82923	2.09114
.10908	.82923	1.68458
.28306	.82923	.80615
.50000	.82923	.40484
.71694	.82923	.32938
.89092	.82923	.16381
.98746	.82923	.00385
.01254	.95424	1.33408
.10908	.95424	1.29537
.28306	.95424	.68826
.50000	.95424	.58164
.71694	.95424	.33570
.89092	.95424	.17859
.98746	.95424	-.12067

SECTIONAL PROPERTIES
****

I	CL	CM	CD	CT
*	**	**	**	**
1	.71699	.18123	.26096	0.00000
2	.80969	.10646	.29470	0.00000
3	.93793	-.19245	.30498	0.00000
4	1.31511	-.16239	.47866	0.00000
5	1.37816	-.37423	.50161	0.00000
6	.90139	-.40234	.32808	0.00000
7	.73109	-.39964	.26609	0.00000
8	.64241	-.41574	.23382	0.00000
9	.56791	-.43157	.20670	0.00000

TOTAL LIFT COEFFICIENT= .86679
TOTAL PITCHING MOMENT COEFFICIENT= -.15059
TOTAL DRAG COEFFICIENT= .31549
TOTAL THRUST COEFFICIENT= 0.00000

SPANWISE PRESSURE AT CONSTANT X=. 0.00000

Y	2Y/B(LOCAL)	DELTA-CP
.03844	.08614	.72062
.13906	.31166	.95651
.26344	.59041	1.22761
.36406	.81593	2.52929

SPANWISE PRESSURE AT CONSTANT X=. 1.00000

Y	2Y/B(LOCAL)	DELTA-CP
.03844	.04257	.57018
.13906	.15401	.57436
.26344	.29177	1.04410
.36406	.40321	.75933
.46061	.51014	1.12420
.61937	.68598	.90551
.83625	.92617	1.08864

FORTRAN PROGRAM LISTING

This program was written in FORTRAN IV language and is operational on CDC Cyber 175 Computer system at Langley Research Center. The run stream (control cards) is listed at the end of the program. The following table is an index to the program listing.

Program or subroutine	Main Purpose	Page
LEVSP	executive routine, prints out free elements in the leading-edge and wake vortex system, and to check convergence	114
TAN	trigonometric function	118
SKIPR	skips records	118
ARCOS	inverse trigonometric function cosine	119
DOTPRD	dot product of two vectors	119
CRSPRD	cross product of two vectors	119
VDTWNG	calculates induced velocity due to wing elements	119
VDTFRE	calculates induced velocity due to free elements	124
NORMAL	computes unit normal vector	128
SWAHC	sidewash correction	128
ABVLE	absolute value of a vector	130
INOUT	check control points by vector analysis	131
ORDER	sets up the order of two parallel vortex segments on the leading-edge free elements	131
F	computes the magnitude of $[(x_1 - x_2)^2 + \beta(y_1 - y_2)^2 + \beta(z_1 - z_2)^2]^{\frac{1}{2}}$	132
CAMBER	calculates camber slopes at wing bound elements and control points	133

ZCDX	defines analytical camber slopes	134
ZCR	determines camber slopes numerically	135
PNLEF	determines control point locations within or without a flat leading-edge flap	136
ZCAM	cubic spline interpolation of camber slopes	137
FUNA	computes induced velocity due to a vortex element in the far field	138
INFL2	computes induced velocity due to a vortex segment in the near field	139
NEWVEL	computes total velocity at a point	140
VMSEQN	vector method for solving simultaneous equations	143
GEOM	defines the wing and free element geometry	144
PNLWNG	generates the grids of bound and trailing vortex elements	154
SHAPLE	defines the shape of leading-edge	156
SHAPTE	defines the shape of trailing-edge	157
FRELM	finds the initial coordinates of free vortex elements	157
SPLINE	cubic spline subroutine	163
APLOT	sets up dimensions for plotting leading-edge and wake elements	164
PLOTT	manipulates leading-edge and wake elements coordinates in a form suitable for plotting	165
LNPLOT	generates plots on line printer	167
SOLN	sets up dimensions for solving the strengths of wing and leading-edge vortex system	170
AERODN	solves strengths of wing and leading-edge vortex system	171

THRST	calculates sectional leading-edge thrust coefficients	174
LOADS	sets up dimensions for evaluating aerodynamic characteristics	175
COEFS	computes aerodynamic characteristics	177
SURFSET	sets up program for surface spline	190
SURFORD	surface spline interpolation	193
MATINV	matrix inversion with accompanying solution of linear equations	193
NEWSHAP	sets up dimensions for computing new locations of leading-edge and trailing-edge vortices by making them force free	196
NEWELM	computes new locations of leading-edge and trailing-edge vortices by making them force free	197
CORE	finds the centroid of the diffused leading-edge vortex element system	214
CFAEC	computes the force on each vortex segment of core	216
SEGMNT	computes the force gradient of each vortex segment of core	217
NEWBC	returns to the previous location	218
NEWDA	saves newly computed locations of leading-edge vortex elements system	219
MODEL	generates the vortex segments along each free element on the free vortex sheet	220
CHOPS	determines the intersection between the centroid of leading-edge vortex system and	222

	the leading-edge vortex filament	
LIRITN	establishes the free sheet and concentrated core	223
AZCORE	adjusts z-coordinates of initial core	228
APEXC	rearranges vortex segments of core	228
AYCORE	adjusts y-coordinates of initial core	229
LEADLM	generates the equal-length vortex segments on each free element	231
CFSET	determines z-coordinates of vortex segments along each free element	232
MINMAX	determines the maximum and minimum of two numbers	232
CENTRD	computes y- and z-coordinates at some stations chosen by the program	233
COORD	coordinates computation	233
CSIPAR	cubic spline fitting	234

```
      OVERLAY (LEVSP,0,0)                                               LEV  10
      PROGRAM LEVSP(INPUT,OUTPUT,TAPE1,TAPE2,TAPE3,TAPE5=INPUT,TAPE6=OUTLEV  20
     1PUT,PUNCH,TAPE4,TAPE7,TAPE8,TAPE9,TAPE10)                         LEV  30
C                                                                       LEV  40
C     AERODYNAMICS OF LOW ASPECT-RATIO WINGS WITH PARTIAL LEADING-EDGE  LEV  50
C     SEPARATION (LEADING-EDGE VORTEX SEPARATION PROGRAM)               LEV  60
C     BY - JENN LOUH PAO , SUDHIR C. MEHROTRA AND C. EDWARD LAN         LEV  70
C          UNIVERSITY OF KANSAS                                         LEV  80
C                                                                       LEV  90
C     THIS PROGRAM IS APPLICABLE TO NONPLANAR WINGS (LIMITED TO TWO     LEV 100
C     SPANWISE SECTIONS )                                               LEV 110
C                                                                       LEV 120
C     PROGRAM IS DIVIDED INTO FIVE OVERLAYS.                            LEV 130
C     OVERLAY (1,0) READ ALL THE DATA CARDS AND SETS UP INITIAL         LEV 140
C                   GEOMETRY OF THE WING AND THE FREE ELEMENTS          LEV 150
C     OVERLAY (2,0) PLOTS FREE ELEMENTS OVER THE WING AND IN THE WAKE ONLEV 160
C                   THE LINE PRINTER OUTPUT                             LEV 170
C     OVERLAY (3,0) SOLVES FOR THE STRENGTHS OF WING AND LEADING-EDGE   LEV 180
C                   VORTEX SYSTEM                                       LEV 190
C     OVERLAY (4,0) COMPUTE THE AERODYNAMICS CHARACTERISTICS , THE      LEV 200
C                   SUM OF FREE SHEET AND CORE FORCES                   LEV 210
C     OVERLAY (5,0) COMPUTES THE NEW LOCATIONS OF THE LEADING-EDGE AND  LEV 220
C                   TRAILING-EDGE VORTICES                              LEV 230
C     AS THE PROBLEM IS NONLINEAR, IT IS SOLVED BY ITERATION. ITERATION LEV 240
C     IS PERFORMED OVER OVERLAYS (2,0) THRU (4,0) TO OBTAIN THE FINAL   LEV 250
C     CONVERGED SOLUTION.                                               LEV 260
C                                                                       LEV 270
      COMMON DUMMY1(3000)                                               LEV 280
      COMMON /COEFF/ CL,FZMINS(10),FHS(2,10),RATIOS(2,10),              LEV 290
     1CFCORE(2,10),RATIOC(2,10)                                         LEV 300
      COMMON /NCTT/ NCT,NCON,NBT,NCOR(15),KU1,NFSH(15),KUC,FLG(10)      LEV 310
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                LEV 320
      COMMON /TAPE/ ITEST,IGOOD,SFAC(10),KU3,NSTOP                      LEV 330
      COMMON /SHPTE/ NTE,YST(15),AQT(14),BQT(14),CQT(14),DQT(14)        LEV 340
      COMMON /SHPLE/ NLE,YSL(15),AQL(14),BQL(14),CQL(14),DQL(14)        LEV 350
      COMMON /LANDA/ FGMA1,FBDA1,FGMA,CLS                               LEV 360
      COMMON /LOCSP/ FTANTY(10,15),FTANTZ(10,15),CTANTY(40,2),CTANTZ(40,LEV 370
     12)                                                                LEV 380
      COMMON /LEFLP/ YLEF(10,2),XNF(10),YNF(10),ZNF(10),XLF(10,4),      LEV 390
     1YLF(10,4),SLP1(10),SS,CS,ITERS,ZBDYV(200),ZBDY(200)               LEV 400
     2,CURV(10),CHND(10),SZBDYV(200)                                    LEV 410
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      COMMON /INFAV/ FYT(20),FZT(20),FYI(40),FZI(40),VXI(40),VYI(40),VZILEV 420
     1(40),FXT(20),TFORCE(20)                                           LEV 430
      COMMON /MDFAV/ FYP(40,2,2),FZP(40,2,2)                            LEV 440
      COMMON /LOC/ FU1,FU2,XEND,PXL(5),PXT(5),PYL(5),ICL                LEV 450
      COMMON /ALLI/ NSW,NSW1,NCW,NWNG,NCPTTL,MITER,IPUNCH               LEV 460
      COMMON /ALLRA/ TTL(16),ALPHA,SINA,COSA,SWPLE,BETA,BETA2,TANPH1,B2PLEV 470
     1H1,BSQD4P,D4,CON,PI,D4SQ2,CBAR,HALFB,AREA                         LEV 480
      COMMON /ALLRB/ AX(210),ZMIN,NELM(11),NNELM(12),IST                LEV 490
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40),XXE(11,20),YYE(11,20), LEV 500
     1ZZE(11,20),NMAX,NNMAX,NCONTS                                      LEV 510
      COMMON /DABC/ DXE(10,40),DYE(10,40),DZE(10,40)                    LEV 520
      COMMON /XPLOT/ XMN,YMN,ZMN,XMX,YMX,ZMX                            LEV 530
      COMMON /GM/ ITER,L1,L2,L3,L4,L5,L6,L7,L8                          LEV 540
      COMMON /XSTN/ XBRR(25),NBRR                                       LEV 550
      COMMON /TIPVX/ XTIP(15,30),YTIP(15,30),ZTIP(15,30),NTLM(15),NTMAX LEV 560
      COMMON /GENCF/ M1(5),NW(2),YBREAK(5),CH(90),SJ(31,3),MJW1(2),     LEV 570
     1MJW2(2),WIDTH(5),SWEEP(60),NTS,NC                                 LEV 580
      COMMON/CAMB/ ICAM,IM(10),XT(10,21),AAM(10,20),BBM(10,20),         LEV 590
     1CCM(10,20),DDM(10,20),YT(10),ZBDX(200),ZBDXV(200)                 LEV 600
10    CALL OVERLAY (5HLEVSP,1,0)                                        LEV 610
      ITEST=9                                                           LEV 620
      IGOOD= 10                                                         LEV 630
      KU3=KU1+3                                                         LEV 640
      NSTOP=0                                                           LEV 650
      NSW1=NTS                                                          LEV 660
      NSW=NTS+1                                                         LEV 670
      ITER=ITERS                                                        LEV 680
20    CONTINUE                                                          LEV 690
      ALP=ALPHA*180./PI                                                 LEV 700
      AMACH=SQRT(1.-BETA2)                                              LEV 710
C     WRITE FREE ELEMENTS LOCATIONS                                     LEV 720
      WRITE (6,140) TTL,ALP,AMACH,ITER                                  LEV 730
      IF (ITER.GE.KU3) WRITE (ITEST,140) TTL,ALP,AMACH,ITER             LEV 740
      DO 30 I=1,MAXL                                                    LEV 750
      K=NELM(I)                                                         LEV 760
      WRITE (6,180) I                                                   LEV 770
      WRITE (6,170) (XE(I,J),J=1,K)                                     LEV 780
      WRITE (6,170) (YE(I,J),J=1,K)                                     LEV 790
30    WRITE (6,170) (ZE(I,J),J=1,K)                                     LEV 800
      WRITE (6,210)                                                     LEV 810
      DO 40 I=1,MAXW                                                    LEV 820
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      K=NNELM(I)                                                        LEV 830
      WRITE (6,180) I                                                   LEV 840
      WRITE (6,170) (XXE(I,J),J=1,K)                                    LEV 850
      WRITE (6,170) (YYE(I,J),J=1,K)                                    LEV 860
40    WRITE (6,170) (ZZE(I,J),J=1,K)                                    LEV 870
      IF (ITER.LT.KU3) GO TO 70                                         LEV 880
      M=ITEST                                                           LEV 890
      DO 50 I=1,MAXL                                                    LEV 900
      K=NELM(I)                                                         LEV 910
      WRITE (M,180) I                                                   LEV 920
      WRITE (M,170) (XE(I,J),J=1,K)                                     LEV 930
      WRITE (M,170) (YE(I,J),J=1,K)                                     LEV 940
      WRITE (M,170) (ZE(I,J),J=1,K)                                     LEV 950
50    CONTINUE                                                          LEV 960
      WRITE (M,210)                                                     LEV 970
      DO 60 I=1,MAXW                                                    LEV 980
      K=NNELM(I)                                                        LEV 990
      WRITE (M,180) I                                                   LEV1000
      WRITE (M,170) (XXE(I,J),J=1,K)                                    LEV1010
      WRITE (M,170) (YYE(I,J),J=1,K)                                    LEV1020
      WRITE (M,170) (ZZE(I,J),J=1,K)                                    LEV1030
60    CONTINUE                                                          LEV1040
70    CONTINUE                                                          LEV1050
      CALL OVERLAY (5HLEVSP,2,0)                                        LEV1060
      NAERO=0                                                           LEV1070
      NSW=NTS+1                                                         LEV1080
      CALL OVERLAY (5HLEVSP,3,0)                                        LEV1090
      NAERO=1                                                           LEV1100
      NSW1=NTS                                                          LEV1110
      NSW=NTS+1                                                         LEV1120
      CALL OVERLAY (5HLEVSP,4,0)                                        LEV1130
      IF (NSTOP.NE.1) GO TO 75                                          LEV1135
      REWIND ITEST                                                      LEV1140
      ENDFILE ITEST                                                     LEV1145
      ENDFILE ITEST                                                     LEV1150
      GO TO 90                                                          LEV1155
  75  RATIOC(1,ITER)=1.                                                 LEV1160
      RATIOC(2,ITER)=1.                                                 LEV1170
      RATIOS(1,ITER)=1.                                                 LEV1180
      RATIOS(2,ITER)=1.                                                 LEV1190
      NSW1=NTS                                                          LEV1200
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```
      NSW=NTS+1                                                         LEV1210
      IF (ITER.LT.KU3) GO TO 80                                         LEV1220
      RATIOS(1,ITER)=ABS((FHS(1,ITER)-FHS(1,ITER-1))/FHS(1,ITER-1))     LEV1230
      RATIOC(1,ITER)=ABS((CFCORE(1,ITER)-CFCORE(1,ITER-1))/CFCORE(1,ITERLEV1240
     1))                                                                LEV1250
      IF (ITRAKE.NE.1) RATIOC(2,ITER)=ABS((CFCORE(2,ITER)-CFCORE(2,ITER-LEV1260
     11))/CFCORE(2,ITER-1))                                             LEV1270
      IF (ITRAKE.NE.1) RATIOS(2,ITER)=ABS((FHS(2,ITER)-FHS(2,ITER-1))/FHLEV1280
     1S(2,ITER-1))                                                      LEV1290
80    CONTINUE                                                          LEV1300
      IF (ITER.EQ.MITER) GO TO 90                                       LEV1310
      CALL OVERLAY (5HLEVSP,5,0)                                        LEV1320
      ITER=ITER+1                                                       LEV1330
      IF (ITER.LE.MITER) GO TO 20                                       LEV1340
90    CONTINUE                                                          LEV1350
      IF (IPUNCH.EQ.0) GO TO 120                                        LEV1360
C     PUNCH-OUT FREE ELEMENTS LOCATIONS AFTER LAST ITERATION            LEV1370
      REWIND 4                                                          LEV1380
      PUNCH 200, (NELM(I),I=1,NSW1)                                     LEV1390
      DO 100 I=1,NSW1                                                   LEV1400
      K=NELM(I)                                                         LEV1410
      PUNCH 190, (XE(I,J),J=1,K)                                        LEV1420
      PUNCH 190, (YE(I,J),J=1,K)                                        LEV1430
100   PUNCH 190, (ZE(I,J),J=1,K)                                        LEV1440
      PUNCH 200, (NNELM(I),I=1,NSW)                                     LEV1450
      DO 110 I=1,NSW                                                    LEV1460
      K=NNELM(I)                                                        LEV1470
      PUNCH 190, (XXE(I,J),J=1,K)                                       LEV1480
      PUNCH 190, (YYE(I,J),J=1,K)                                       LEV1490
110   PUNCH 190, (ZZE(I,J),J=1,K)                                       LEV1500
C     FORMULATION OF SUMMARY SHEET                                      LEV1510
120   REWIND 7                                                          LEV1520
      WRITE (6,150) TTL,ALP,AMACH                                       LEV1530
      MIT=MITER+1                                                       LEV1540
      IF (ITERS.EQ.0) KSS=1                                             LEV1550
      IF (ITERS.EQ.3) KSS=4                                             LEV1560
      DO 130 I=KSS,MIT                                                  LEV1570
      J=I-1                                                             LEV1580
C     ******************************************************************LEV1590
      READ (7) GMSUM                                                    LEV1600
      READ (7) CL,CM,CD,CTT                                             LEV1610
```

```
C     ***********************************************************LEV1620
      IF (ITER.LE.KU1) WRITE (6,160) J,CL,CM,CD,CTT,GMSUM          LEV1630
      IF (ITER.GT.KU1) WRITE (6,160) J,CL,CM,CD,CTT,GMSUM,SFAC(J)  LEV1640
130   CONTINUE                                                     LEV1650
      GO TO 10                                                     LEV1660
C                                                                  LEV1680
140   FORMAT (1H1,//,16A5,/,1X,12HALPHA(DEG.)=,F6.3,14H  MACH NUMBER=,F6LEV1690
     1.3,19H  ITERATION NUMBER=,I2,//,1X,21HLEADING EDGE ELEMENTS,/,1X,2LEV1700
     21H*********************)                                      LEV1710
150   FORMAT (1H1,//,1X,16A5,//,2X,12HALPHA(DEG.)=,F6.3,14H  MACH NUMBERLEV1720
     1=,F6.3,//,66H  ITERATION    CL       CM       CD       CT    GMSUM   LEV1730
     2 SFAC          ,/,58H  *********    **       **       **       **    **LEV1740
     3***    ****)                                                 LEV1750
160   FORMAT (I7,4X,6F8.4)                                         LEV1760
170   FORMAT (1H ,14F9.4)                                          LEV1770
180   FORMAT (1H ,5H ****,I2,4H****)                               LEV1780
190   FORMAT (8F10.4)                                              LEV1790
200   FORMAT (10I2)                                                LEV1800
210   FORMAT (1H1,//,14H WAKE ELEMENTS,/,14H *************)        LEV1810
      END                                                          LEV1820-


      FUNCTION TAN(X)                                              TAN  10
      TAN=SIN(X)/COS(X)                                            TAN  20
      RETURN                                                       TAN  30
      END                                                          TAN  40-


      SUBROUTINE SKIPR (NT,NR)                                     SKP  10
C     SKIPS NR-RECORDS OF TAPE NT                                  SKP  20
      DO 10 I=1,NR                                                 SKP  30
10    READ (NT)                                                    SKP  40
      RETURN                                                       SKP  50
      END                                                          SKP  60-


      FUNCTION ARCOS (X)                                           ARC  10
C     CALCULATES ARC-COSINE OF X                                   ARC  20
```

```
      ARCOS=0.                                                          ARC  30
      IF (X.EQ.1.) RETURN                                               ARC  40
      IF (X.EQ.(-1.)) GO TO 10                                          ARC  50
      XX=X/(SQRT(1.-X*X))                                               ARC  60
      ARCOS=1.5707963-ATAN(XX)                                          ARC  70
      RETURN                                                            ARC  80
10    ARCOS=3.1415926                                                   ARC  90
      RETURN                                                            ARC 100
      END                                                               ARC 110-


      SUBROUTINE DOTPRD (A,B,SUM)                                       DOT  10
C     CALCULATES DOT-PRODUCT OF TWO VECTORS                             DOT  20
      DIMENSION A(3), B(3)                                              DOT  30
      SUM=0.                                                            DOT  40
      DO 10 I=1,3                                                       DOT  50
10    SUM=SUM+A(I)*B(I)                                                 DOT  60
      RETURN                                                            DOT  70
      END                                                               DOT  80-


      SUBROUTINE CRSPRD (A,B,C)                                         CRS  10
C     CALCULATES CROSS-PRODUCT OF TWO VECTORS                           CRS  20
      DIMENSION A(3), B(3), C(3)                                        CRS  30
      C(1)=A(2)*B(3)-A(3)*B(2)                                          CRS  40
      C(2)=A(3)*B(1)-A(1)*B(3)                                          CRS  50
      C(3)=A(1)*B(2)-A(2)*B(1)                                          CRS  60
      RETURN                                                            CRS  70
      END                                                               CRS  80-


      SUBROUTINE VDTWNG (C,THETP,XX,YY,ZZ,XN,YN,XTE,YTE,CONS,CONI1,CONI3WNG  10
     1,CONJ1,CONJ2,CONJ3,CONK1,CONK2,CONK3,CONI,CONJ,CONK,SI,NSW1,NCW,NWWNG  20
     2NG)                                                               WNG  30
C     EVALUATES INFLUENCE COEFFICIENTS FOR CALCULATION OF INDUCED       WNG  40
C     VELOCITY DUE TO WING ELEMENTS                                     WNG  50
      COMMON /ALLI/ NSW                                                 WNG  60
      COMMON /ALLRB/ XXE(30),YYE(30),ZZE(30)                            WNG  70
```

```
     1,AX(120),ZMIN,NELM(11),NNELM(12)                                  WNG  80
      COMMON /ABC/ PXE(10,40),PYE(10,40),PZE(10,40),PXXE(11,20),        WNG  90
     1PYYE(11,20),PZZE(11,20),NMAX,NNMAX,NCONTS                         WNG 100
      COMMON /NCTT/ NCT,NCON,NRT,NCOR(15),KU1,NFSH(15),KUC              WNG 110
      COMMON /GENCF/ M1(5),NW(2),YBREAK(5),CH(90),SJ(31,3),MJW1(2),     WNG 120
     1MJW2(2),WIDTH(5),SWEEP(60),NTS,NC                                 WNG 130
      COMMON /LOC/ FU1,FU2,XEND,PXL(5),PXT(5),PYL(5)                    WNG 140
      COMMON /AERO/ NAFRO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                WNG 150
      COMMON /TIPVX/ XTIP(15,30),YTIP(15,30),ZTIP(15,30),NTLM(15)       WNG 160
      COMMON /XIYIZI/ XI,YI,ZI                                          WNG 170
      DIMENSION THETP(1), C(1), CONS(1), XTE(1), YTE(1), SI(1), CONI1(1)WNG 180
     1, CONI3(1), CONJ1(1), CONJ2(1), CONJ3(1), CONK1(1), CONK2(1), CONKWNG 190
     23(1), CONI(1), CONJ(1), CONK(1), XN(NWNG,2), YN(NWNG,2), B(3), D(3WNG 200
     3)                                                                 WNG 210
C     DIMENSIONS OF FJ1,FJ2,FJ3-(2*NSW)  ** SEE GEOM **                 WNG 220
C     DIMENSIONS OF FI2,FI3-(2*NCPTTL)  ** SEE GEOM **                  WNG 230
      DIMENSION FJ1(40), FJ2(40), FJ3(40), FI2(418), FI3(418)           WNG 240
      XI=XX                                                             WNG 250
      YI=YY                                                             WNG 260
      ZI=ZZ                                                             WNG 270
      NC1=NWNG+NCW                                                      WNG 280
      NC2=NWNG-NCW                                                      WNG 290
C     VELOCITY DUE TO BOUND ELEMENTS                                    WNG 300
      NSW1=NTS                                                          WNG 310
      DO 10 I=1,NSW1                                                    WNG 320
      DO 10 J=1,NCW                                                     WNG 330
      NP=(I-1)*NCW+J                                                    WNG 340
      CALL INFL2 (XN(NP,1),YN(NP,1),0.,XN(NP,2),YN(NP,2),0.,B)          WNG 350
      A1=-YN(NP,1)                                                      WNG 360
      A2=-YN(NP,2)                                                      WNG 370
      CALL INFL2 (XN(NP,1),A1,0.,XN(NP,2),A2,0.,D)                      WNG 380
      CONI(NP)=CONS(I)*(B(1)-D(1))                                      WNG 390
      CONJ(NP)=CONS(I)*(B(2)-D(2))                                      WNG 400
10    CONK(NP)=CONS(I)*(B(3)-D(3))                                      WNG 410
C     VELOCITY DUE TO TRAILING ELEMENTS ON THE WING SURFACE             WNG 420
      DO 20 I=1,NSW1                                                    WNG 430
      DO 20 J=1,NCW                                                     WNG 440
      NP=(I-1)*NCW+J                                                    WNG 450
      CALL INFL2 (XN(NP,1),YN(NP,1),0.,XTE(I),YN(NP,1),0.,B)            WNG 460
      FI2(NP)=B(2)                                                      WNG 470
      FI3(NP)=B(3)                                                      WNG 480
```

```
      AYN=-YN(NP,1)                                                     WNG 490
      NQ=NC1+NP                                                         WNG 500
      CALL INFL2 (XN(NP,1),AYN,0.,XTE(I),AYN,0.,B)                      WNG 510
      FI2(NQ)=B(2)                                                      WNG 520
      FI3(NQ)=B(3)                                                      WNG 530
20    CONTINUE                                                          WNG 540
      IF ((PXT(NC+1)-PXL(NC+1)).EQ.0.) GO TO 40                         WNG 550
      DO 30 I=1,NCW                                                     WNG 560
      NP1=NWNG+I                                                        WNG 570
      NP2=NC1+NP1                                                       WNG 580
      FI2(NP1)=0.                                                       WNG 590
      FI2(NP2)=0.                                                       WNG 600
      FI3(NP1)=0.                                                       WNG 610
      FI3(NP2)=0.                                                       WNG 620
      NN=NTLM(I)-1                                                      WNG 630
      DO 30 J=1,NN                                                      WNG 640
      CALL INFL2 (XTIP(I,J),YTIP(I,J),ZTIP(I,J),XTIP(I,J+1),YTIP(I,J+1),WNG 650
     1ZTIP(I,J+1),B)                                                    WNG 660
      FI2(NP1)=B(2)+FI2(NP1)                                            WNG 670
      FI3(NP1)=B(3)+FI3(NP1)                                            WNG 680
      AY1=-YTIP(I,J)                                                    WNG 690
      AY2=-YTIP(I,J+1)                                                  WNG 700
      CALL INFL2 (XTIP(I,J),AY1,ZTIP(I,J),XTIP(I,J+1),AY2,ZTIP(I,J+1),B)WNG 710
      FI2(NP2)=B(2)+FI2(NP2)                                            WNG 720
      FI3(NP2)=B(3)+FI3(NP2)                                            WNG 730
30    CONTINUE                                                          WNG 740
      GO TO 60                                                          WNG 750
40    CONTINUE                                                          WNG 760
      DO 50 J=1,NCW                                                     WNG 770
      NP1=NWNG+J                                                        WNG 780
      NP2=NC1+NP1                                                       WNG 790
      NP=NC2+J                                                          WNG 800
      CALL INFL2 (XN(NP,2),YN(NP,2),0.,XTE(NSW),YN(NP,2),0.,B)          WNG 810
      FI2(NP1)=B(2)                                                     WNG 820
      FI3(NP1)=B(3)                                                     WNG 830
      AYN=-YN(NP,2)                                                     WNG 840
      CALL INFL2 (XN(NP,2),AYN,0.,XTE(NSW),AYN,0.,B)                    WNG 850
      FI2(NP2)=B(2)                                                     WNG 860
      FI3(NP2)=B(3)                                                     WNG 870
50    CONTINUE                                                          WNG 880
60    CONTINUE                                                          WNG 890
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      DO 70 I=1,NSW1                                                    WNG 900
      DO 70 J=1,NCW                                                     WNG 910
      NP=(I-1)*NCW+J                                                    WNG 920
      I1=NP+NC1                                                         WNG 930
      I2=NP+NCW                                                         WNG 940
      I3=I1+NCW                                                         WNG 950
      CONJ2(NP)=CONS(I)*(FI2(I1)-FI2(NP)+FI2(I2)-FI2(I3))               WNG 960
70    CONK2(NP)=CONS(I)*(FI3(I1)-FI3(NP)+FI3(I2)-FI3(I3))               WNG 970
C     VELOCITY DUE TO TRAILING ELEMENTS BEYOND TRAILING EDGE            WNG 980
      NSW1=MAXL                                                         WNG 990
      IF ((PXT(NC+1)-PXL(NC+1)).EQ.0.) GO TO 90                         WNG1000
      DO 80 I=1,NSW                                                     WNG1010
      FJ1(I)=0.                                                         WNG1020
      FJ2(I)=0.                                                         WNG1030
      FJ3(I)=0.                                                         WNG1040
      FJ1(I+NSW)=0.                                                     WNG1050
      FJ2(I+NSW)=0.                                                     WNG1060
      FJ3(I+NSW)=0.                                                     WNG1070
80    CONTINUE                                                          WNG1080
      NT=NSW1                                                           WNG1090
      GO TO 100                                                         WNG1100
90    NT=NSW                                                            WNG1110
100   CONTINUE                                                          WNG1120
      DO 150 I=2,NT                                                     WNG1130
      KK=NNELM(I)                                                       WNG1140
      DO 110 J=1,KK                                                     WNG1150
      XXE(J)=PXXE(I,J)                                                  WNG1160
      YYE(J)=PYYE(I,J)                                                  WNG1170
      ZZE(J)=PZZE(I,J)                                                  WNG1180
110   CONTINUE                                                          WNG1190
      FJ1(I)=0.                                                         WNG1200
      FJ2(I)=0.                                                         WNG1210
      FJ3(I)=0.                                                         WNG1220
      IF (I.EQ.NCT) GO TO 130                                           WNG1230
      DO 120 J=2,KK                                                     WNG1240
      CALL INFL2 (XXE(J-1),YYE(J-1),ZZE(J-1),XXE(J),YYE(J),ZZE(J),B)    WNG1250
      FJ1(I)=FJ1(I)+B(1)                                                WNG1260
      FJ2(I)=FJ2(I)+B(2)                                                WNG1270
      FJ3(I)=FJ3(I)+B(3)                                                WNG1280
120   CONTINUE                                                          WNG1290
      CALL FUNA (XXE(KK),YYE(KK),ZZE(KK),B(1),B(2),B(3))                WNG1300
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      FJ1(I)=FJ1(I)+B(1)                                                WNG1310
      FJ2(I)=FJ2(I)+B(2)                                                WNG1320
      FJ3(I)=FJ3(I)+B(3)                                                WNG1330
130   CONTINUE                                                          WNG1340
      IN=I+NSW                                                          WNG1350
      FJ1(IN)=0.                                                        WNG1360
      FJ2(IN)=0.                                                        WNG1370
      FJ3(IN)=0.                                                        WNG1380
      DO 140 J=2,KK                                                     WNG1390
      AYT1=-YYE(J-1)                                                    WNG1400
      AYT2=-YYE(J)                                                      WNG1410
      CALL INFL2 (XXE(J-1),AYT1,ZZE(J-1),XXE(J),AYT2,ZZE(J),B)          WNG1420
      FJ1(IN)=FJ1(IN)+B(1)                                              WNG1430
      FJ2(IN)=FJ2(IN)+B(2)                                              WNG1440
      FJ3(IN)=FJ3(IN)+B(3)                                              WNG1450
140   CONTINUE                                                          WNG1460
      AYT2=-YYE(KK)                                                     WNG1470
      CALL FUNA (XXE(KK),AYT2,ZZE(KK),B(1),B(2),B(3))                   WNG1480
      FJ1(IN)=FJ1(IN)+B(1)                                              WNG1490
      FJ2(IN)=FJ2(IN)+B(2)                                              WNG1500
      FJ3(IN)=FJ3(IN)+B(3)                                              WNG1510
150   CONTINUE                                                          WNG1520
      FJ1(1)=0.                                                         WNG1530
      FJ2(1)=0.                                                         WNG1540
      FJ3(1)=0.                                                         WNG1550
      FJ1(NSW+1)=0.                                                     WNG1560
      FJ2(NSW+1)=0.                                                     WNG1570
      FJ3(NSW+1)=0.                                                     WNG1580
      DO 160 I=1,NSW1                                                   WNG1590
      I1=I+1                                                            WNG1600
      I2=I+NSW                                                          WNG1610
      I3=I2+1                                                           WNG1620
      EFJ1=CONS(I)*(FJ1(I2)-FJ1(I)+FJ1(I1)-FJ1(I3))                     WNG1630
      EFJ2=CONS(I)*(FJ2(I2)-FJ2(I)+FJ2(I1)-FJ2(I3))                     WNG1640
      EFJ3=CONS(I)*(FJ3(I2)-FJ3(I)+FJ3(I1)-FJ3(I3))                     WNG1650
      DO 160 J=1,NCW                                                    WNG1660
      NP=(I-1)*NCW+J                                                    WNG1670
      CONI3(NP)=EFJ1                                                    WNG1680
      CONJ3(NP)=EFJ2                                                    WNG1690
160   CONK3(NP)=EFJ3                                                    WNG1700
C     TOTAL INDUCED VELOCITY                                            WNG1710
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      I=1                                                               WNG1720
      DO 170 J=1,NWNG                                                   WNG1730
      CONI(J)=(CONI(J)+CONI3(J))*SI(I)                                  WNG1740
      CONJ(J)=(CONJ(J)+CONJ2(J)+CONJ3(J))*SI(I)                         WNG1750
      CONK(J)=(CONK(J)+CONK2(J)+CONK3(J))*SI(I)                         WNG1760
      I=I+1                                                             WNG1770
      IF (I.GT.NCW) I=1                                                 WNG1780
170   CONTINUE                                                          WNG1790
      RETURN                                                            WNG1800
      END                                                               WNG1810-


      SUBROUTINE VDTFRE (X,Y,Z,CI,CJ,CK,NSW1,BSOD4P,XLE,YLE)            FRE  10
C     EVALUATES INFLUENCE COEFFICIENTS FOR CALCULATION OF INDUCED       FRE  20
C     VELOCITY DUE TO FREE ELEMENTS                                     FRE  30
      COMMON /ALLRB/ XE(40),YE(40),ZE(40),XXE(30),YYE(30),ZZE(30)       FRE  40
     1,ZMIN,NELM(11),NNELM(12)                                          FRE  50
      COMMON /ABC/ PXE(10,40),PYE(10,40),PZE(10,40),PXXE(11,20),        FRE  60
     1PYYE(11,20),PZZE(11,20),NMAX,NNMAX,NCONTS                         FRE  70
      COMMON /NCTT/ NCT,NCON,NBT,NCOR(15),KU1,NFSH(15),KUC,FLG(10)      FRE  80
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                FRE  90
      COMMON /GENCF/ M1(5),NW(2),YBREAK(5),CH(90),SJ(31,3),MJW1(2),     FRE 100
     1MJW2(2),WIDTH(5),SWEEP(60),NTS,NC                                 FRE 110
      COMMON /LOC/ FU1,FU2,XEND,PXL(5),PXT(5),PYL(5)                    FRE 120
      DIMENSION P(5),Q(5),R(5)                                          FRE 130
      COMMON /GM/ ITER                                                  FRE 140
      COMMON /XIYIZI/ XI,YI,ZI                                          FRE 150
      DIMENSION CI(1), CJ(1), CK(1), XLE(1), YLE(1), V(3), VVV(3)       FRE 160
C     DIMENSION OF VTDL-(NSW1,3)  ** SEE GEOM **                        FRE 170
      DIMENSION VTDL(19,3)                                              FRE 180
      XI=X                                                              FRE 190
      YI=Y                                                              FRE 200
      ZI=Z                                                              FRE 210
      NCT1=0                                                            FRE 220
10    CONTINUE                                                          FRE 230
      IF (ISPAN.EQ.0) NSW1=NTS                                          FRE 240
      IF (ISPAN.EQ.1) NSW1=MAXL                                         FRE 250
      DO 90 I=1,NSW1                                                    FRE 260
      NCR=NCOR(I)                                                       FRE 270
      V(1)=0.                                                           FRE 280
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      V(2)=0.                                                           FRE 290
      V(3)=0.                                                           FRE 300
      FJ1=0.                                                            FRE 310
      FJ2=0.                                                            FRE 320
      FJ3=0.                                                            FRE 330
      KK=NELM(I)                                                        FRE 340
      DO 20 J=1,KK                                                      FRE 350
      XE(J)=PXE(I,J)                                                    FRE 360
      YE(J)=PYE(I,J)                                                    FRE 370
      ZE(J)=PZE(I,J)                                                    FRE 380
20    CONTINUE                                                          FRE 390
      K=KK-1                                                            FRE 400
C     VELOCITY DUE TO FREE ELEMENTS AHEAD OF TRAILING-EDGE AND THOSE    FRE 410
C     OVER THE WING                                                     FRE 420
      DO 40 J=1,K                                                       FRE 430
      IF (ITER.GT.KU1.AND.I.EQ.1.AND.J.GE.3.AND.J.LT.NCR) GO TO 40      FRE 440
      IF (ITER.GT.KU1.AND.I.EQ.M1(1).AND.J.GE.3.AND.J.LT.NCR.AND.ITRAKE.FRE 450
     1NE.1) GO TO 40                                                    FRE 460
      IF (ABS(XE(J+1)-XI).LE.1.E-5) GO TO 40                            FRE 470
      IF (I.EQ.NCON.AND.J.GT.4.AND.YI.GT.0.AND.ITER.LE.KU1) GO TO 40    FRE 480
      IF (I.EQ.NCON.AND.NBT.EQ.0.AND.J.GT.4.AND.J.LT.NCR.AND.YI.GT.0.ANDFRE 490
     1.ITER.GT.KU1) GO TO 40                                            FRE 500
      IF (ITER.GT.KU1.AND.J.GE.NCR.AND.YI.GT.0.AND.NBT.EQ.1) GO TO 40   FRE 510
      CALL INFL2 (XE(J),YE(J),ZE(J),XE(J+1),YE(J+1),ZE(J+1),VVV)        FRE 520
      IF (ITER.LE.KU1) GO TO 30                                         FRE 530
      IF (J.LT.NCR) GO TO 30                                            FRE 540
      IF (NAERO.EQ.0) GO TO 30                                          FRE 550
      IF (NCT1.GT.0.AND.J.LT.NCR) GO TO 30                              FRE 560
C     INDUCED VELOCITIES MODIFIED BY VISCOUS CORE EFFECT                FRE 570
      P(1)=XE(J)-XE(J+1)                                                FRE 580
      P(2)=YE(J)-YE(J+1)                                                FRE 590
      P(3)=ZE(J)-ZE(J+1)                                                FRE 600
      CALL ABVLE (P,SUM)                                                FRE 610
      IF (SUM.LE.1.E-5) GO TO 30                                        FRE 620
      P(1)=P(1)/SUM                                                     FRE 630
      P(2)=P(2)/SUM                                                     FRE 640
      P(3)=P(3)/SUM                                                     FRE 650
      Q(1)=XI-XE(J+1)                                                   FRE 660
      Q(2)=YI-YE(J+1)                                                   FRE 670
      Q(3)=ZI-ZE(J+1)                                                   FRE 680
      CALL CRSPRD (P,Q,R)                                               FRE 690
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      CALL ARVLE (P,D1)                                                 FRE 700
      L1=1                                                              FRE 710
      L3=M1(1)-1                                                        FRE 720
      IF (ITRAKE.NE.1.AND.I.GE.M1(1)) L1=M1(1)                          FRE 730
      IF (ITRAKE.NE.1.AND.I.GE.M1(1)) L3=M1(2)                          FRE 740
      P(1)=PXE(L3,4)-PXE(L1,4)                                          FRE 750
      P(2)=PYE(L3,4)-PYE(L1,4)                                          FRE 760
      P(3)=PZE(L3,4)-PZE(L1,4)                                          FRE 770
      CALL ARVLE (P,SUM)                                                FRE 780
      P(1)=P(1)/SUM                                                     FRE 790
      P(2)=P(2)/SUM                                                     FRE 800
      P(3)=P(3)/SUM                                                     FRE 810
      Q(1)=XE(J+1)-PXE(L1,4)                                            FRE 820
      Q(2)=YE(J+1)-PYE(L1,4)                                            FRE 830
      Q(3)=ZE(J+1)-PZE(L1,4)                                            FRE 840
      CALL CRSPRD (P,Q,R)                                               FRE 850
      CALL ARVLE (R,D2)                                                 FRE 860
      D2=0.75*D2                                                        FRE 870
      RATIO=D1/D2                                                       FRE 880
      IF (RATIO.GT.1.) GO TO 30                                         FRE 890
      VVV(2)=VVV(2)*(RATIO**2)                                          FRE 900
      VVV(3)=VVV(3)*(RATIO**2)                                          FRE 910
30    CONTINUE                                                          FRE 920
      V(1)=V(1)+VVV(1)                                                  FRE 930
      V(2)=V(2)+VVV(2)                                                  FRE 940
      V(3)=V(3)+VVV(3)                                                  FRE 950
      IF (ITER.LE.KU1) GO TO 40                                         FRE 960
      CORR=0.                                                           FRE 970
      IF (NAERO.EQ.0) GO TO 40                                          FRE 980
      IF (NBT.EQ.0) GO TO 40                                            FRE 990
      IF (I.EQ.NSW1) GO TO 40                                           FRE1000
      IF (ITRAKE.NE.1.AND.I.EQ.M1(1)-1) GO TO 40                        FRE1010
      IF (J.LE.4.OR.J.GE.NCP-1) GO TO 40                                FRE1020
C     SIDEWASH CORRECTION FACTOR                                        FRE1030
      CALL ORDER (I,J,P,Q,R)                                            FRE1040
      CALL SWAHC (I,P,Q,R,XI,YI,ZI,CORR)                                FRE1050
      V(2)=V(2)+CORR                                                    FRE1060
40    CONTINUE                                                          FRE1070
      IF (ITER.LE.KU1.AND.I.EQ.NCON.AND.YI.GT.0.) GO TO 50              FRE1080
      IF (ITER.GT.KU1.AND.NBT.EQ.1.AND.YI.GT.0.) GO TO 50               FRE1090
      CALL FUNA (XE(K+1),YE(K+1),ZE(K+1),FJ1,FJ2,FJ3)                   FRE1100
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50    VTDL(I,1)=V(1)+FJ1                                                FRE1110
      VTDL(I,2)=V(2)+FJ2                                                FRE1120
      VTDL(I,3)=V(3)+FJ3                                                FRE1130
      FJ1=0.                                                            FRE1140
      FJ2=0.                                                            FRE1150
      FJ3=0.                                                            FRE1160
      IF ((PXT(NC+1)-PXL(NC+1)).NE.0..AND.I.EQ.NSW1) GO TO 80           FRE1170
      I1=I+1                                                            FRE1180
      II=NNELM(I1)                                                      FRE1190
      DO 60 J=1,II                                                      FRE1200
      XXE(J)=PXXE(I1,J)                                                 FRE1210
      YYE(J)=PYYE(I1,J)                                                 FRE1220
      ZZE(J)=PZZE(I1,J)                                                 FRE1230
60    CONTINUE                                                          FRE1240
      IF (I1.EQ.NCT.AND.YI.GT.0.) GO TO 80                              FRE1250
C     VELOCITY DUE TO WAKE ELEMENTS                                     FRE1260
      DO 70 J=2,II                                                      FRE1270
      CALL INFL2 (XXE(J-1),YYE(J-1),ZZE(J-1),XXE(J),YYE(J),ZZE(J),V)    FRE1280
      FJ1=FJ1+V(1)                                                      FRE1290
      FJ2=FJ2+V(2)                                                      FRE1300
      FJ3=FJ3+V(3)                                                      FRE1310
70    CONTINUE                                                          FRE1320
      CALL FUNA (XXE(II),YYE(II),ZZE(II),V(1),V(2),V(3))                FRE1330
      FJ1=FJ1+V(1)                                                      FRE1340
      FJ2=FJ2+V(2)                                                      FRE1350
      FJ3=FJ3+V(3)                                                      FRE1360
80    CONTINUE                                                          FRE1370
      VTDL(I,1)=VTDL(I,1)-FJ1                                           FRE1380
      VTDL(I,2)=VTDL(I,2)-FJ2                                           FRE1390
      VTDL(I,3)=VTDL(I,3)-FJ3                                           FRE1400
90    CONTINUE                                                          FRE1410
      YI=-YI                                                            FRE1420
      NCT1=NCT1+1                                                       FRE1430
      IF (NCT1.GT.1) GO TO 110                                          FRE1440
      DO 100 I=1,NSW1                                                   FRE1450
      CI(I)=VTDL(I,1)                                                   FRE1460
      CJ(I)=VTDL(I,2)                                                   FRE1470
      CK(I)=VTDL(I,3)                                                   FRE1480
100   CONTINUE                                                          FRE1490
      GO TO 10                                                          FRE1500
C     TOTAL INDUCED VELOCITY                                            FRE1510
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110   DO 120 I=1,NSW1                                                FRE1520
      CI(I)=RSQD4P*(CI(I)+VTDL(I,1))                                 FRE1530
      CJ(I)=RSQD4P*(CJ(I)-VTDL(I,2))                                 FRE1540
120   CK(I)=RSQD4P*(CK(I)+VTDL(I,3))                                 FRE1550
      RETURN                                                         FRE1560
      END                                                            FRE1570-


      SUBROUTINE NORMAL (X,Y,Z,UN)                                   NOR  10
      DIMENSION X(5),Y(5),Z(5),A(3),B(3),C(3),UN(3)                  NOR  20
      A(1)=X(3)-X(1)                                                 NOR  30
      A(2)=Y(3)-Y(1)                                                 NOR  40
      A(3)=Z(3)-Z(1)                                                 NOR  50
      B(1)=X(4)-X(2)                                                 NOR  60
      B(2)=Y(4)-Y(2)                                                 NOR  70
      B(3)=Z(4)-Z(2)                                                 NOR  80
      CALL CRSPRD (B,A,C)                                            NOR  90
      CALL ABVLE (C,ABSN)                                            NOR 100
      IF (ABSN.LE.1.E-5) GO TO 10                                    NOR 110
      UN(1)=C(1)/ABSN                                                NOR 120
      UN(2)=C(2)/ABSN                                                NOR 130
      UN(3)=C(3)/ABSN                                                NOR 140
      RETURN                                                         NOR 150
10    UN(1)=0.                                                       NOR 160
      UN(2)=0.                                                       NOR 170
      UN(3)=0.                                                       NOR 180
      RETURN                                                         NOR 190
      END                                                            NOR 200-


      SUBROUTINE SWAHC (I,X,Y,Z,XI,YI,ZI,CORR)                       SWH  10
      DIMENSION X(5),Y(5),Z(5),A(3),B(3),C(3),UN(3),FLPC(4)          SWH  20
      COMMON /NCTT/ NCT,NCON,NPT,NCOR(15),KU1,NFSH(15),KUC,FLG(10)   SWH  30
C     FIND THE FOUR CORNER POINTS AFTER PLANE  TRANSFORMATION        SWH  40
      CALL NORMAL (X,Y,Z,UN)                                         SWH  50
      XBAR=0.25*(X(1)+X(2)+X(3)+X(4))                                SWH  60
      YBAR=0.25*(Y(1)+Y(2)+Y(3)+Y(4))                                SWH  70
      ZBAR=0.25*(Z(1)+Z(2)+Z(3)+Z(4))                                SWH  80
      DSD=ABS(UN(1)*(XBAR-X(1))+UN(2)*(YBAR-Y(1))+UN(3)*(ZBAR-Z(1)))  SWH  90
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      IF (DSD.EQ.0.) GO TO 30                                           SWH 100
C     NEW PLANAR CORNER POINTS                                          SWH 110
      DO 10 K=1,4                                                       SWH 120
      X(K)=X(K)+(-1)**(K+1)*UN(1)*DSD                                   SWH 130
      Y(K)=Y(K)+(-1)**(K+1)*UN(2)*DSD                                   SWH 140
      Z(K)=Z(K)+(-1)**(K+1)*UN(3)*DSD                                   SWH 150
10    CONTINUE                                                          SWH 160
      CALL NORMAL (X,Y,Z,UN)                                            SWH 170
      IF (UN(1).EQ.0..AND.UN(2).EQ.0..AND.UN(3).EQ.0.) GO TO 30         SWH 180
      X(5)=X(1)                                                         SWH 190
      Y(5)=Y(1)                                                         SWH 200
      Z(5)=Z(1)                                                         SWH 210
C     FIND THE SHORTEST DISTANCE FROM THE CONTROL POINT TO THE PLANE    SWH 220
      A(1)=X(1)-XI                                                      SWH 230
      A(2)=Y(1)-YI                                                      SWH 240
      A(3)=Z(1)-ZI                                                      SWH 250
      CALL DOTPRD (A,UN,VDS)                                            SWH 260
      XO=XI+VDS*UN(1)                                                   SWH 270
      YO=YI+VDS*UN(2)                                                   SWH 280
      ZO=ZI+VDS*UN(3)                                                   SWH 290
      CALL INOUT (X,Y,XO,YO,NSIDE)                                      SWH 300
      IF (NSIDE.NE.1) GO TO 30                                          SWH 310
C     FIND THE DISTANCE BETWEEN THE INTERSECTION POINT TO ALL EDGES OF  SWH 320
C     PANEL                                                             SWH 330
      DO 20 K=1,4                                                       SWH 340
      B(1)=XO-X(K)                                                      SWH 350
      B(2)=YO-Y(K)                                                      SWH 360
      B(3)=ZO-X(K)                                                      SWH 370
      A(1)=X(K+1)-X(K)                                                  SWH 380
      A(2)=Y(K+1)-Y(K)                                                  SWH 390
      A(3)=Z(K+1)-Z(K)                                                  SWH 400
      CALL ABVLE (A,DPD)                                                SWH 410
      A(1)=A(1)/DPD                                                     SWH 420
      A(2)=A(2)/DPD                                                     SWH 430
      A(3)=A(3)/DPD                                                     SWH 440
      CALL CRSPRD (B,A,C)                                               SWH 450
      CALL ABVLE (C,DP)                                                 SWH 460
      FLPC(K)=DP                                                        SWH 470
20    CONTINUE                                                          SWH 480
      FLPC(1)=-ABS(FLPC(1))                                             SWH 490
      FY=FLPC(4)/F(FLPC(4),0.,0.,0.,VDS)+FLPC(2)/F(FLPC(2),0.,0.,0.,VDS)SWH 500
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      CY1=FLPC(1)                                                       SWH 510
      CY2=FLPC(3)                                                       SWH 520
      CZ1=VDS                                                           SWH 530
      CZ2=VDS                                                           SWH 540
      IF (ABS(CZ1).LE.1.E-5.OR.ABS(CZ2).LE.1.E-5) GO TO 30              SWH 550
      G2=CY1**2+CZ1**2                                                  SWH 560
      G3=CY2**2+CZ2**2                                                  SWH 570
      G4=CZ2/G3+CZ1/G2                                                  SWH 580
      AVGG=(FLG(I)+FLG(I+1))/2.                                         SWH 590
      G5=-0.5*FY*G4*AVGG*1.1                                            SWH 600
      G6=CZ2/ABS(CZ2)*ATAN(CY2/ABS(CZ2))                                SWH 610
      G7=CZ1/ABS(CZ1)*ATAN(CY1/ABS(CZ1))                                SWH 620
      G8=FY*(G6-G7)*AVGG/(FLPC(3)-FLPC(1))                              SWH 630
      CORR=(G5+G8)/AVGG                                                 SWH 640
C     FIND THE SIDE WASH CORRECTION FACTOR IN THE  LOCAL PANEL Y        SWH 650
      A(1)=X(3)-X(2)                                                    SWH 660
      A(2)=Y(3)-Y(2)                                                    SWH 670
      A(3)=Z(3)-Z(2)                                                    SWH 680
      CALL ABVLE (A,TOL)                                                SWH 690
      A(1)=A(1)/TOL                                                     SWH 700
      A(2)=A(2)/TOL                                                     SWH 710
      A(3)=A(3)/TOL                                                     SWH 720
      B(1)=X(4)-X(1)                                                    SWH 730
      B(2)=Y(4)-Y(1)                                                    SWH 740
      B(3)=Z(4)-Z(1)                                                    SWH 750
      CALL ABVLE (B,TOL)                                                SWH 760
      B(1)=B(1)/TOL                                                     SWH 770
      B(2)=B(2)/TOL                                                     SWH 780
      B(3)=B(3)/TOL                                                     SWH 790
      CC=(A(2)+B(2))/2.                                                 SWH 800
      CORR=CORR*CC                                                      SWH 810
      GO TO 40                                                          SWH 820
30    CORR=0.                                                           SWH 830
40    CONTINUE                                                          SWH 840
      RETURN                                                            SWH 850
      END                                                               SWH 860-


      SUBROUTINE ABVLE (A,ABSUM)                                        ABV  10
      DIMENSION A(3)                                                    ABV  20
```

```
      ABSUM=SQRT(A(1)**2+A(2)**2+A(3)**2)                               ABV  30
      RETURN                                                            ABV  40
      END                                                               ABV  50-


      SUBROUTINE INOUT (X,Y,XO,YO,NSIDE)                                INO  10
C     TO CHECK THE CONTROL PT BY VECTOR ANALYSIS                        INO  20
       DIMENSION X(5),Y(5)                                              INO  30
      X(5)=X(1)                                                         INO  40
      Y(5)=Y(1)                                                         INO  50
      NSIDE=1                                                           INO  60
      DO 10 I=1,4                                                       INO  70
      VECT=(XO-X(I))*(Y(I+1)-Y(I))-(X(I+1)-X(I))*(YO-Y(I))              INO  80
      IF (VECT.LT.0.) NSIDE=0                                           INO  90
10    CONTINUE                                                          INO 100
      RETURN                                                            INO 110
      END                                                               INO 120-


      SUBROUTINE ORDER (I,J,X,Y,Z)                                      ODR  10
      DIMENSION X(5),Y(5),Z(5)                                          ODR  20
      COMMON /ABC/ PXE(10,40),PYE(10,40),PZE(10,40)                     ODR  30
      X(1)=PXE(I,J+1)                                                   ODR  40
      Y(1)=PYE(I,J+1)                                                   ODR  50
      Z(1)=PZE(I,J+1)                                                   ODR  60
      X(5)=X(1)                                                         ODR  70
      Y(5)=Y(1)                                                         ODR  80
      Z(5)=Z(1)                                                         ODR  90
      X(2)=PXE(I,J)                                                     ODR 100
      Y(2)=PYE(I,J)                                                     ODR 110
      Z(2)=PZE(I,J)                                                     ODR 120
      X(3)=PXE(I+1,J)                                                   ODR 130
      Y(3)=PYE(I+1,J)                                                   ODR 140
      Z(3)=PZE(I+1,J)                                                   ODR 150
      X(4)=PXE(I+1,J+1)                                                 ODR 160
      Y(4)=PYE(I+1,J+1)                                                 ODR 170
      Z(4)=PZE(I+1,J+1)                                                 ODR 180
      RETURN                                                            ODR 190
      END                                                               ODR 200-
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```
      FUNCTION F(X1,X,Y1,Y,Z1,Z)                                        FUN  10
      COMMON /ALLRA/ TTL(16),ALPHA,SINA,COSA,SWPLF,BETA,BETA2           FUN  20
      XX=X1-X                                                           FUN  30
      YY=Y1-Y                                                           FUN  40
      ZZ=Z1-Z                                                           FUN  50
      F=SQRT(XX**2+BETA2*YY**2+BETA2*ZZ**2)                             FUN  60
      RETURN                                                            FUN  70
      END                                                               FUN  80-


      SUBROUTINE CAMBER (NPRCY,C,XCP,YCP,XN,YN,XLM,YLM,XAVWNG,YAVWNG)   CBR  10
      DIMENSION XN(190,2),YN(190,2),C(19),XLM(19),YLM(19)               CBR  20
      DIMENSION XCP(209),YCP(209),XAVWNG(190),YAVWNG(190)               CBR  30
      COMMON /ALLRB/ AX(210),ZMIN,NELM(11),NNELM(12),IST                CBR  40
      COMMON /ALLI/ NSW,NSW1,NCW,NWNG                                   CBR  50
      COMMON /LEFLP/ YLEF(10,2),XNF(10),YNF(10),ZNF(10),XLF(10,4),      CBR  60
     1YLF(10,4),SLP1(10),SS,CS,ITERS,ZBDYV(200),ZBDY(200)               CBR  70
     2,CURV(10),CHND(10),SZBDYV(200)                                    CBR  80
      COMMON/CAMB/ ICAM,IM(10),XT(10,21),AAM(10,20),BBM(10,20),         CBR  90
     1CCM(10,20),DDM(10,20),YT(10),ZBDX(200),ZBDXV(200)                 CBR 100
C     NPRCY = 0 , FINE GRIDS                                            CBR 110
C     NPRCY = 1 , 2 , COARSE GRIDS.                                     CBR 120
      IF (NPRCY.EQ.2) GO TO 90                                          CBR 130
      IF (NPRCY.EQ.1) GO TO 10                                          CBR 140
      IF (NPRCY.EQ.0) GO TO 60                                          CBR 150
10    CONTINUE                                                          CBR 160
C     FIND THE CAMBER SLOPE AT CONTROL POINTS                           CBR 170
      DO 30 I=1,NSW1                                                    CBR 180
      DO 30 J=1,NCW                                                     CBR 190
      IJ=(I-1)*NCW+J                                                    CBR 200
      XC=(XCP(IJ)-XLM(I))/C(I)                                          CBR 210
      IF (ICAM.EQ.3) XC=XCP(IJ)                                         CBR 220
      IF (ICAM.EQ.2) GO TO 20                                           CBR 230
      YK1=(YCP(IJ)-YN(IJ,1))/(YN(IJ,2)-YN(IJ,1))                        CBR 240
      XK1=XN(IJ,1)+(XN(IJ,2)-XN(IJ,1))*YK1                              CBR 250
      X1=(XK1-XLM(I))/C(I)                                              CBR 260
      CALL ZCR (XC,YCP(IJ),DZDX,ICAM,X1,1,C,DZDY)                       CBR 270
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      ZBDX(IJ)=DZDX                                                     CBR 280
      ZBDY(IJ)=DZDY                                                     CBR 290
      GO TO 30                                                          CBR 300
20    YC=YLM(I)                                                         CBR 310
      XC=XCP(IJ)                                                        CBR 320
      CALL ZCDX (XC,YC,DZDX,DZDY)                                       CBR 330
      ZBDX(IJ)=DZDX                                                     CBR 340
      ZBDY(IJ)=DZDY                                                     CBR 350
30    CONTINUE                                                          CBR 360
C     FIND THE CAMBER SLOPE AT LEADING-EDGE CONTROL POINTS              CBR 370
      DO 50 I=1,NSW1                                                    CBR 380
      IJ=NWNG+I                                                         CBR 390
      XC=0.                                                             CBR 400
      IF (ICAM.EQ.2) GO TO 40                                           CBR 410
      IF (ICAM.EQ.3) XC=XLM(I)                                          CBR 420
      Z1=XC                                                             CBR 430
      CALL ZCR (XC,YLM(I),DZDX,ICAM,Z1,1,C,DZDY)                        CBR 440
      ZBDX(IJ)=DZDX                                                     CBR 450
      ZBDY(IJ)=DZDY                                                     CBR 460
      GO TO 50                                                          CBR 470
40    XC=XLM(I)                                                         CBR 480
      YC=YLM(I)                                                         CBR 490
      CALL ZCDX (XC,YC,DZDX,DZDY)                                       CBR 500
      ZBDX(IJ)=DZDX                                                     CBR 510
      ZBDY(IJ)=DZDY                                                     CBR 520
50    CONTINUE                                                          CBR 530
      RETURN                                                            CBR 540
60    CONTINUE                                                          CBR 550
C     FIND CAMBER SLOPE AT BOUND ELEMENTS                               CBR 560
      DO 80 I=1,NSW1                                                    CBR 570
      DO 80 J=1,NCW                                                     CBR 580
      IJ=(I-1)*NCW+J                                                    CBR 590
      XC=(XAVWNG(IJ)-XLM(I))/C(I)                                       CBR 600
      IF (ICAM.EQ.3) XC=XAVWNG(IJ)                                      CBR 610
      IF (ICAM.EQ.2) GO TO 70                                           CBR 620
      Z1=XC                                                             CBR 630
      CALL ZCR (XC,YAVWNG(IJ),DZDX,ICAM,Z1,1,C,DZDY)                    CBR 640
      ZBDXV(IJ)=DZDX                                                    CBR 650
      ZBDYV(IJ)=DZDY                                                    CBR 660
      GO TO 80                                                          CBR 670
70    YC=YLM(I)                                                         CBR 680
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      XC=XAVWNG(IJ)                                                     CBR 690
      CALL ZCDX (XC,YC,DZDX,DZDY)                                       CBR 700
      ZBDXV(IJ)=DZDX                                                    CBR 710
      ZBDYV(IJ)=DZDY                                                    CBR 720
80    CONTINUE                                                          CBR 730
      RETURN                                                            CBR 740
90    CONTINUE                                                          CBR 750
C     FIND CAMBER SLOPE AT BOUND ELEMENTS                               CBR 760
      DO 110 I=1,NSW1                                                   CBR 770
      DO 110 J=1,NCW                                                    CBR 780
      IJ=(I-1)*NCW+J                                                    CBR 790
      XC=(XAVWNG(IJ)-XLM(I))/C(I)                                       CBR 800
      IF (ICAM.EQ.3) XC=XAVWNG(IJ)                                      CBR 810
      IF (ICAM.EQ.2) GO TO 100                                          CBR 820
      Z1=XC                                                             CBR 830
      CALL ZCP (XC,YAVWNG(IJ),DZDX,ICAM,Z1,1,C,DZDY)                    CBR 840
      SZBDYV(IJ)=DZDY                                                   CBR 850
      GO TO 110                                                         CBR 860
100   YC=YLM(I)                                                         CBR 870
      XC=XAVWNG(IJ)                                                     CBR 880
      CALL ZCDX (XC,YC,DZDX,DZDY)                                       CBR 890
      SZBDYV(IJ)=DZDY                                                   CBR 900
110   CONTINUE                                                          CBR 910
      RETURN                                                            CBR 920
      END                                                               CBR 930-


      SUBROUTINE ZCDX (X,Y,ZCX,DZDY)                                    ZCD  10
C     DEFINE THE CAMBER SLOPE, DZDX, AT ANY X, Y LOCATION IN CLOSE FORM,ZCD  20
C     WHERE X AND DIMENSIONAL COORDINATES REFERED TO C.G.               ZCD  30
C     CONICAL CAMBER FOR A CONFIGURATION IN NASA CR-2002                ZCD  40
C                                                                       ZCD  50
      YB=0.231303*(1.6+X)                                               ZCD  60
      ZCX=0.                                                            ZCD  70
      DZDY=0.                                                           ZCD  80
      IF (Y.LT.YB) Y=0.                                                 ZCD  90
      IF (Y.LT.YB) RETURN                                               ZCD 100
      XX=X                                                              ZCD 110
      R=0.06821207*(1.6+XX)                                             ZCD 120
      ZC=-R+SQRT(R*R-(Y-YB)**2)                                         ZCD 130
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      ZCX=(0.231303*(Y-YB)-0.068212*ZC)/(ZC+R)                          ZCD 140
      DZDY=-(Y-YB)/(ZC+R)                                               ZCD 150
      Y=ZC                                                              ZCD 160
C     Y IS RETURNED AS THE Z COORDINATE.                                ZCD 170
      RETURN                                                            ZCD 180
      END                                                               ZCD 190-


      SUBROUTINE ZCR (X,Y,DZDX,ICAM,X1,KP,CHORD,DZDY)                   ZCR  10
      COMMON /ALLRB/ AX(210),ZMIN,NELM(11),NNELM(12),IST                ZCR  20
      COMMON /LEFLP/ YLEF(10,2),XNF(10),YNF(10),ZNF(10),XLF(10,4),      ZCR  30
     1YLF(10,4),SLP1(10),SS,CS,ITERS,ZBDYV(200),ZBDY(200)               ZCR  40
     2,CURV(10),CHND(10)                                                ZCR  50
      XE=X1                                                             ZCR  60
      KK=DZDX                                                           ZCR  70
      RR=DZDY                                                           ZCR  80
      DZDX=0.                                                           ZCR  90
      DZDY=0.                                                           ZCR 100
      IF (ICAM.EQ.1) GO TO 50                                           ZCR 110
      IF (ICAM.NE.3) GO TO 60                                           ZCR 120
      X1=0.                                                             ZCR 130
      I=1                                                               ZCR 140
10    IF (Y.GE.YLEF(I,1).AND.Y.LE.YLEF(I,2)) GO TO 20                   ZCR 150
      I=I+1                                                             ZCR 160
      IF (I.GE.IST) GO TO 60                                            ZCR 170
      IF (I.EQ.11) GO TO 60                                             ZCR 180
      GO TO 10                                                          ZCR 190
20    YB=YLF(I,1)+SLP1(I)*(X-XLF(I,1))                                  ZCR 200
      KCON=0                                                            ZCR 210
      IF (KK.NE.100) GO TO 30                                           ZCR 220
      XB=XLF(I,1)                                                       ZCR 230
      IF (SLP1(I).GT.1.E-18) XB=XLF(I,1)+(Y-YLF(I,1))/SLP1(I)           ZCR 240
      DX=RR/(XB-XE)                                                     ZCR 250
      IF (ABS(1.-DX).LE.0.1) KCON=1                                     ZCR 260
      IF (KCON.EQ.1) GO TO 40                                           ZCR 270
30    CONTINUE                                                          ZCR 280
      IF (Y.LE.YB) RETURN                                               ZCR 290
40    CONTINUE                                                          ZCR 300
      TEST1=PNLEF(X,Y,XLF,YLF,I,1,2)                                    ZCR 310
      IF (ABS(TEST1).LT.1.E-8.AND.Y.GE.YLF(I,1)) TEST1=1.E-8            ZCR 320
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      IF (TEST1.LT.0.) RETURN                                           ZCR 330
      TEST2=PNLEF(X,Y,XLF,YLF,I,4,3)                                    ZCR 340
      IF (ABS(TEST2).LT.1.E-8.AND.Y.LE.YLF(I,3)) TEST2=1.E-8            ZCR 350
      IF (TEST2.GT.0.) RETURN                                           ZCR 360
      DZDX=-XNF(I)/ZNF(I)                                               ZCR 370
      DZDY=-YNF(I)/ZNF(I)                                               ZCR 380
      D=-XNF(I)*XLF(I,1)-YNF(I)*YLF(I,1)                                ZCR 390
      X1=-(D+XNF(I)*X+YNF(I)*Y)/ZNF(I)                                  ZCR 400
      IF (KCON.EQ.0) GO TO 60                                           ZCR 410
      DZDX=0.5*DZDX                                                     ZCR 420
      DZDY=0.5*DZDY                                                     ZCR 430
      X1=0.                                                             ZCR 440
      GO TO 60                                                          ZCR 450
50    CALL ZCAM (X,Y,ZR,X1,KP,CHORD)                                    ZCR 460
60    RETURN                                                            ZCR 470
      END                                                               ZCR 480-


      FUNCTION PNLEF(X,Y,XLF,YLF,I,J,K)                                 PNL  10
      DIMENSION XLF(10,4),YLF(10,4)                                     PNL  20
      PNLEF=(X-XLF(I,J))*(YLF(I,K)-YLF(I,J))-(XLF(I,K)-XLF(I,J))*(Y-YLF(PNL  30
     1I,J))                                                             PNL  40
      RETURN                                                            PNL  50
      END                                                               PNL  60-


      SUBROUTINE ZCAM (X,Y,ZR,X1,KP,CHORD)                              ZCM  10
      DIMENSION ZZ(2),ZQ(2),C(15)                                       ZCM  20
      COMMON /ALLRB/ AX(210),ZMIN,BX(23),IST                            ZCM  30
      COMMON/CAMB/ ICAM,IM(10),XT(10,21),AAM(10,20),BBM(10,20),         ZCM  40
     1CCM(10,20),DDM(10,20),YT(10),ZBDX(200),ZBDXV(200)                 ZCM  50
      COMMON /LEFLP/ YLEF(10,2),XNF(10),YNF(10),ZNF(10),XLF(10,4),      ZCM  60
     1YLF(10,4),SLP1(10),SS,CS,ITERS,ZBDYV(200),ZBDY(200)               ZCM  70
     2,CURV(10),CHND(10)                                                ZCM  80
      I=KP                                                              ZCM  90
      ZR=0.                                                             ZCM 100
10    IF (Y.GT.YT(I).AND.Y.LT.YT(I+1)) GO TO 30                         ZCM 110
      I=I+1                                                             ZCM 120
      IF (I.GT.IST) GO TO 20                                            ZCM 130
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      GO TO 10                                                          ZCM 140
20    IF (Y.LT.YT(1)) I=1                                               ZCM 150
      IF (Y.GT.YT(IST)) I=IST-1                                         ZCM 160
30    IK=1                                                              ZCM 170
      XF=0.                                                             ZCM 180
      ICV=CURV(I)                                                       ZCM 190
      IF (ICV.EQ.1) GO TO 40                                            ZCM 200
      XF1=XT(I,2)*CHND(I)                                               ZCM 210
      IF (ABS(DDM(I,1)).LE.0.0001) XF1=XT(I,1)*CHND(I)                  ZCM 220
      XF2=XT(I+1,2)*CHND(I+1)                                           ZCM 230
      YF=(Y-YT(I))/(YT(I+1)-YT(I))                                      ZCM 240
      XF=(XF1+(XF2-XF1)*YF)/CHORD                                       ZCM 250
      IF (X1.GT.XF) GO TO 40                                            ZCM 260
      FAC=CHND(I+1)                                                     ZCM 270
      IF (FAC.LE.0.0001) FAC=1.                                         ZCM 280
      DELTA=DDM(I,1)*CHND(I)+(DDM(I+1,1)*FAC-DDM(I,1)*CHND(I))*YF       ZCM 290
      DELTA=DELTA/CHORD                                                 ZCM 300
      IF (IM(I).GT.2) ZQ(1)=DDM(I,2)*CHND(I)                            ZCM 310
      IF (IM(I).LE.2) ZQ(1)=(CCM(I,1)+DDM(I,1))*CHND(I)                 ZCM 320
      IF (IM(I+1).GT.2) ZQ(2)=DDM(I+1,2)*FAC                            ZCM 330
      IF (IM(I+1).LE.2) ZQ(2)=(CCM(I+1,1)+DDM(I+1,1))*FAC               ZCM 340
      DK=(ZQ(1)+(ZQ(2)-ZQ(1))*YF)/CHORD                                 ZCM 350
      DELTA=DELTA-DK                                                    ZCM 360
      GO TO 110                                                         ZCM 370
40    K=1                                                               ZCM 380
      IF (ICV.EQ.0) GO TO 150                                           ZCM 390
50    IF (X.GE.XT(I,K).AND.X.LT.XT(I,K+1)) GO TO 60                     ZCM 400
      K=K+1                                                             ZCM 410
      IF (K.GE.IM(I)) GO TO 70                                          ZCM 420
      GO TO 50                                                          ZCM 430
60    SM=X-XT(I,K)                                                      ZCM 440
      ZZ(IK)=3.*AAM(I,K)*SM*SM+2.*BBM(I,K)*SM+CCM(I,K)                  ZCM 450
      GO TO 90                                                          ZCM 460
70    IF (X.LT.XT(I,1)) GO TO 80                                        ZCM 470
      K=IM(I)-1                                                         ZCM 480
      GO TO 60                                                          ZCM 490
80    K=1                                                               ZCM 500
      GO TO 60                                                          ZCM 510
90    IF (IK.EQ.2) GO TO 100                                            ZCM 520
      I=I+1                                                             ZCM 530
      IK=IK+1                                                           ZCM 540
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      GO TO 40                                                          ZCM 550
100   YF=(Y-YT(I-1))/(YT(I)-YT(I-1))                                    ZCM 560
      ZR=ZZ(1)+(ZZ(2)-ZZ(1))*YF                                         ZCM 570
      GO TO 150                                                         ZCM 580
110   IF (X.LT.XF) GO TO 140                                            ZCM 590
      PI=3.14159265                                                     ZCM 600
      C(1)=-DELTA                                                       ZCM 610
      JR=15                                                             ZCM 620
      DO 120 J=2,JR                                                     ZCM 630
      XK=(J-1)*PI*XF                                                    ZCM 640
120   C(J)=-2.*DELTA*SIN(XK)/XK                                         ZCM 650
      ZR=0.                                                             ZCM 660
      DO 130 J=1,JR                                                     ZCM 670
      XK=(J-1)*PI*X                                                     ZCM 680
130   ZR=ZR+C(J)*COS(XK)                                                ZCM 690
      GO TO 150                                                         ZCM 700
140   ZR=-DELTA/XF                                                      ZCM 710
150   CONTINUE                                                          ZCM 720
      RETURN                                                            ZCM 730
      END                                                               ZCM 740-


      SUBROUTINE FUNA (XT,YT,ZT,FJ1,FJ2,FJ3)                            FNA  10
C     INDUCED VELOCITY DUE TO A VORTEX ELEMENT OF UNIT STRENGTH TRAILINGFNA  20
C     FROM (XT,YT,ZT) TO INFINITY                                       FNA  30
      COMMON /ALLRA/ AA(21),BETA2,TANPH1,B2PH1,AB,D4,AC(2),D4SQ2        FNA  40
      COMMON /XIYIZI/ XI,YI,ZI                                          FNA  50
      DIMENSION A(3), B(3), C(3)                                        FNA  60
      A(1)=XT-XI                                                        FNA  70
      A(2)=YT-YI                                                        FNA  80
      A(3)=ZT-ZI                                                        FNA  90
      B(1)=XT+1-XI                                                      FNA 100
      B(2)=YT-YI                                                        FNA 110
      B(3)=ZT+TANPH1-ZI                                                 FNA 120
      CALL CRSPRD (A,B,C)                                               FNA 130
      CC=SQRT(C(1)*C(1)+C(2)*C(2)+C(3)*C(3))                            FNA 140
      IF (CC.LE.(1.E-10)) GO TO 10                                      FNA 150
      D5=2.*(B2PH1*(ZT-ZI-XT*TANPH1)-XI)                                FNA 160
      D6=XI*XI+BETA2*((YI-YT)**2+(ZT-ZI-XT*TANPH1)**2)                  FNA 170
      Q=4.*D4*D6-D5*D5                                                  FNA 180
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      IF (Q.LE.(1.E-10)) GO TO 10                                       FNA 190
      RB=SQRT(D4*XT*XT+D5*XT+D6)                                        FNA 200
      FJ4=2.*(D4SQ2-(2.*D4*XT+D5)/RB)/Q                                 FNA 210
      FJ1=(YT-YI)*TANPH1*FJ4                                            FNA 220
      FJ2=(ZT-ZI+(XI-XT)*TANPH1)*FJ4                                    FNA 230
      FJ3=-(YT-YI)*FJ4                                                  FNA 240
      RETURN                                                            FNA 250
10    FJ1=0.                                                            FNA 260
      FJ2=0.                                                            FNA 270
      FJ3=0.                                                            FNA 280
      RETURN                                                            FNA 290
      END                                                               FNA 300-
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      SUBROUTINE INFL2 (X1,Y1,Z1,X2,Y2,Z2,VACL)                         INF  10
C     INDUCED VELOCITY DUE TO A VORTEX ELEMENT OF UNIT STRENGTH LYING   INF  20
C     BETWEEN (X1,Y1,Z1) AND (X2,Y2,Z2)                                 INF  30
      COMMON /ALLRA/ AA(20),BETA                                        INF  40
      COMMON /XIYIZI/ XI,YI,ZI                                          INF  50
      DIMENSION VA(3), VL(3), VAP(3), VBP(3), VLP(3), VACL(3), VAPCLP(3) INF  60
      VA(1)=X1-XI                                                       INF  70
      VA(2)=Y1-YI                                                       INF  80
      VA(3)=Z1-ZI                                                       INF  90
      VL(1)=X2-X1                                                       INF 100
      VL(2)=Y2-Y1                                                       INF 110
      VL(3)=Z2-Z1                                                       INF 120
      VAP(1)=VA(1)                                                      INF 130
      VAP(2)=BETA*VA(2)                                                 INF 140
      VAP(3)=BETA*VA(3)                                                 INF 150
      VBP(1)=X2-XI                                                      INF 160
      VBP(2)=BETA*(Y2-YI)                                               INF 170
      VBP(3)=BETA*(Z2-ZI)                                               INF 180
      VLP(1)=VL(1)                                                      INF 190
      VLP(2)=BETA*VL(2)                                                 INF 200
      VLP(3)=BETA*VL(3)                                                 INF 210
      CALL CRSPRD (VA,VL,VACL)                                          INF 220
      CALL CRSPRD (VAP,VLP,VAPCLP)                                      INF 230
      CALL DOTPRD (VAPCLP,VAPCLP,DAPCLP)                                INF 240
      IF (ABS(DAPCLP).LT.(1.E-10)) GO TO 10                             INF 250
      CALL DOTPRD (VBP,VBP,DBP)                                         INF 260
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      BPMOD=SQRT(DBP)                                                   INF 270
      CALL DOTPRD (VAP,VAP,DAP)                                         INF 280
      APMOD=SQRT(DAP)                                                   INF 290
      CALL DOTPRD (VBP,VLP,DBPLP)                                       INF 300
      DBPLP=DBPLP/BPMOD                                                 INF 310
      CALL DOTPRD (VAP,VLP,DAPLP)                                       INF 320
      DAPLP=DAPLP/APMOD                                                 INF 330
      CONST=(DBPLP-DAPLP)/DAPCLP                                        INF 340
      GO TO 20                                                          INF 350
10    CONST=0.                                                          INF 360
20    CONTINUE                                                          INF 370
      VACL(1)=VACL(1)*CONST                                             INF 380
      VACL(2)=VACL(2)*CONST                                             INF 390
      VACL(3)=VACL(3)*CONST                                             INF 400
      RETURN                                                            INF 410
      END                                                               INF 420-


      SUBROUTINE NEWVEL (C,THETP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,COVEL  10
     1NI,CONJ,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,CPCW1,XCP,YCP,VEL  20
     2GAMA,YYM)                                                         VEL  30
C     EVALUATES TOTAL VELOCITY AT POINT (XEE,YEE,ZEE)                   VEL  40
      COMMON /INDEX/ IND                                                VEL  50
      COMMON /NCTT/ NCT,NCON,NPT,NCOR(15),KU1,NFSH(15),KUC              VEL  60
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                VEL  70
      COMMON /LOC/ FU1,FU2,XEND,PXL(5),PXT(5),PYL(5)                    VEL  80
      COMMON /GENCE/ M1(5),NW(2),YBREAK(5),CH(90),SJ(31,3),MJW1(2),     VEL  90
     1MJW2(2),WIDTH(5),SWEEP(60),NTS,NC                                 VEL 100
      COMMON /ALLRA/ AA(17),SINA,COSA,AR(5),BSQD4P                      VEL 110
      COMMON /GM/ ITER,L1,L2,L3,L4,L5,L6,L7,L8                          VEL 120
      DIMENSION DUMMY(1), CONI(1), CONJ(1), CONK(1), CI(1), CJ(1), CK(1)VEL 130
     1, C(1), THETP(1), XTE(1), XLE(1), YLE(1), CONS(1), SI(1), CPCW1(1)VEL 140
     2, XCP(1), YCP(1), GAMA(1), YYM(1), XN(NWNG,2), YN(NWNG,2), NP(4), VEL 150
     3U(4,3), V(3)                                                      VEL 160
      NSW1=NTS                                                          VEL 170
C     IF POINT IS IN THE WING PLANE, THE REGULAR METHOD FOR VELOCITY    VEL 180
C     EVALUATION IS USED.                                               VEL 190
      IF (ZEE.LE.0.00001) GO TO 130                                     VEL 200
      IF (YEE.GT.YYM(NSW1)) GO TO 130                                   VEL 210
      IF (ITRAKE.NE.1.AND.YEE.GT.PYL(2)) GO TO 10                       VEL 220
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      CH1=XTE(1)-XLE(1)                                                 VEL 230
      CH2=XTE(2)-XLE(2)                                                 VEL 240
      GO TO 20                                                          VEL 250
10    CH1=PXT(2)-PXL(2)                                                 VEL 260
      CH2=PXT(3)-PXL(3)                                                 VEL 270
20    CONTINUE                                                          VEL 280
      XLY=XLE(1)+(YEE-YLE(1))*(XLE(2)-XLE(1))/(YLE(2)-YLE(1))           VEL 290
      CHY=CH1+(YEE-YLE(1))*(CH2-CH1)/(YLE(2)-YLE(1))                    VEL 300
      XC=(XEE-XLY)/CHY                                                  VEL 310
      IF (XC.LT.0.0.OR.XC.GT.1.0) GO TO 130                             VEL 320
      ZC=ZEF/CHY                                                        VEL 330
C     IF THE POINT (XEE,YEE,ZEE) IS AT Z/C(LOCAL) LESS THAN ZTOL, THE   VEL 340
C     VELOCITY IS OBTAINED BY LINEAR INTERPOLATION OF THE VELOCITIES    VEL 350
C     CALCULATED ABOVE FOUR WING CONTROL POINTS AMONG WHICH THE POINT ISVEL 360
C     LOCATED. BY NUMERICAL EXPERIMENTATION ZTOL HAS BEEN OBTAINED TO BEVEL 370
C     0.2.                                                              VEL 380
      ZTOL=0.2                                                          VEL 390
      IF (ZC.GE.ZTOL) GO TO 130                                         VEL 400
      I=1                                                               VEL 410
      IF (YEE.LE.YYM(I)) GO TO 40                                       VEL 420
30    IF (YEE.GT.YYM(I).AND.YEE.LE.YYM(I+1)) GO TO 40                   VEL 430
      I=I+1                                                             VEL 440
      IF (I.LT.NSW1) GO TO 30                                           VEL 450
40    J=1                                                               VEL 460
      IF (XC.LE.CPCW1(1)) GO TO 70                                      VEL 470
50    IF (XC.GT.CPCW1(J).AND.XC.LE.CPCW1(J+1)) GO TO 60                 VEL 480
      J=J+1                                                             VEL 490
      IF (J.LT.NCW) GO TO 50                                            VEL 500
60    NP(1)=(I-1)*NCW+J                                                 VEL 510
      NP(2)=NP(1)+1                                                     VEL 520
      NP(3)=NP(1)+NCW                                                   VEL 530
      NP(4)=NP(3)+1                                                     VEL 540
      XC1=CPCW1(J)                                                      VEL 550
      XC2=CPCW1(J+1)                                                    VEL 560
      GO TO 80                                                          VEL 570
70    NP(1)=NCW*NSW1+I                                                  VEL 580
      NP(2)=(I-1)*NCW+1                                                 VEL 590
      NP(3)=NP(1)+1                                                     VEL 600
      NP(4)=NP(2)+NCW                                                   VEL 610
      XC1=0.                                                            VEL 620
      XC2=CPCW1(1)                                                      VEL 630
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80    CONTINUE                                                          VEL 640
C     EVALUATION OF INDUCED VELOCITY AT FOUR POINTS                     VEL 650
      DO 100 I=1,4                                                      VEL 660
      NN=NP(I)                                                          VEL 670
      CALL VDTWNG (C,THETP,XCP(NN),YCP(NN),ZEE,XN,YN,XTE,YLE,CONS,DUMMY(VEL 680
     1L1),DUMMY(L2),DUMMY(L3),DUMMY(L4),DUMMY(L5),DUMMY(L6),DUMMY(L7),DUVEL 690
     2MMY(L8),CONI,CONJ,CONK,SI,NSW1,NCW,NWNG)                          VEL 700
      U(I,1)=0.                                                         VEL 710
      U(I,2)=0.                                                         VEL 720
      U(I,3)=0.                                                         VEL 730
      DO 90 J=1,NWNG                                                    VEL 740
      U(I,1)=U(I,1)+CONI(J)*GAMA(J)                                     VEL 750
      U(I,2)=U(I,2)+CONJ(J)*GAMA(J)                                     VEL 760
      U(I,3)=U(I,3)+CONK(J)*GAMA(J)                                     VEL 770
90    CONTINUE                                                          VEL 780
100   CONTINUE                                                          VEL 790
C     INTERPOLATION                                                     VEL 800
      NN1=NP(1)                                                         VEL 810
      NN2=NP(3)                                                         VEL 820
      Y1=YCP(NN1)                                                       VEL 830
      Y2=YCP(NN2)                                                       VEL 840
      DO 110 I=1,3                                                      VEL 850
      UA=U(1,I)+(U(3,I)-U(1,I))*(YEE-Y1)/(Y2-Y1)                        VEL 860
      UB=U(2,I)+(U(4,I)-U(2,I))*(YEE-Y1)/(Y2-Y1)                        VEL 870
110   V(I)=UA+(UB-UA)*(XC-XC1)/(XC2-XC1)                                VEL 880
      UU=V(1)+COSA                                                      VEL 890
      VV=V(2)                                                           VEL 900
      WW=V(3)+SINA                                                      VEL 910
      CALL VDTFRE (XEE,YEE,ZEE,CI,CJ,CK,NSW1,RSQD4P,XLE,YLE)            VEL 920
C     FINAL TOTAL VELOCITY                                              VEL 930
      DO 120 J=1,MAXL                                                   VEL 940
      JJ=NWNG+J                                                         VEL 950
      UU=UU+CI(J)*GAMA(JJ)                                              VEL 960
      VV=VV+CJ(J)*GAMA(JJ)                                              VEL 970
      WW=WW+CK(J)*GAMA(JJ)                                              VEL 980
120   CONTINUE                                                          VEL 990
      RETURN                                                            VEL1000
C     EVALUATION OF VELOCITY WHEN POINT IS IN THE WING PLANE            VEL1010
130   CONTINUE                                                          VEL1020
      CALL VDTWNG (C,THETP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY(L1),DUMMVEL1030
     1Y(L2),DUMMY(L3),DUMMY(L4),DUMMY(L5),DUMMY(L6),DUMMY(L7),DUMMY(L8),VEL1040
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     2CONI,CONJ,CONK,SI,NSW1,NCW,NWNG)                                  VEL1050
      CALL VDTFRE (XEE,YEE,ZEE,CI,CJ,CK,NSW1,BSQD4P,XLE,YLE)            VEL1060
      UU=COSA                                                           VEL1070
      VV=0.                                                             VEL1080
      WW=SINA                                                           VEL1090
C     VELOCITY DUE TO FREE ELEMENTS                                     VEL1100
      DO 140 I=1,MAXL                                                   VEL1110
      NQ=NWNG+I                                                         VEL1120
      UU=UU+CI(I)*GAMA(NQ)                                              VEL1130
      VV=VV+CJ(I)*GAMA(NQ)                                              VEL1140
      WW=WW+CK(I)*GAMA(NQ)                                              VEL1150
140   CONTINUE                                                          VEL1160
C     VELOCITY DUE TO WING                                              VEL1170
      DO 150 I=1,NTS                                                    VEL1180
      DO 150 J=1,NCW                                                    VEL1190
      NQ=(I-1)*NCW+J                                                    VEL1200
      UU=UU+CONI(NQ)*GAMA(NQ)                                           VEL1210
      VV=VV+CONJ(NQ)*GAMA(NQ)                                           VEL1220
      WW=WW+CONK(NQ)*GAMA(NQ)                                           VEL1230
150   CONTINUE                                                          VEL1240
      NSW1=NTS                                                          VEL1250
      NSW=NTS+1                                                         VEL1260
      RETURN                                                            VEL1270
      END                                                               VEL1280-


      SUBROUTINE VMSEQN (NC1,K,AA,A,CA)                                 VMS  10
      DIMENSION AA(1),CA(1),A(1)                                        VMS  20
      NC=K*NC1                                                          VMS  30
      SUM1=0.                                                           VMS  40
      K1=K-1                                                            VMS  50
      JJ=1                                                              VMS  60
      DO 10 J=1,K1                                                      VMS  70
      SUM1=SUM1+AA(J)*A(JJ)                                             VMS  80
10    JJ=JJ+NC1+1                                                       VMS  90
      SUM1=SUM1+AA(K)                                                   VMS 100
      DO 30 I=1,NC1                                                     VMS 110
      SUM2=0.                                                           VMS 120
      JJ=I+1                                                            VMS 130
      DO 20 J=1,K1                                                      VMS 140
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      SUM2=SUM2+AA(J)*A(JJ)                                          VMS 150
20    JJ=JJ+NC1+1                                                    VMS 160
      KK=K+I                                                         VMS 170
      SUM2=SUM2+AA(KK)                                               VMS 180
30    CA(I)=-SUM2/SUM1                                               VMS 190
      M=1                                                            VMS 200
      L=0                                                            VMS 210
      KNC=(K-1)*NC1                                                  VMS 220
      DO 60 I=1,NC                                                   VMS 230
      IF (I.GT.KNC) GO TO 50                                         VMS 240
      MM=(M-1)*NC1+1                                                 VMS 250
      IF (I.EQ.MM) GO TO 70                                          VMS 260
40    KK=KK+1                                                        VMS 270
      IL=I+L                                                         VMS 280
      A(I)=CA(KK)*BASE+A(IL)                                         VMS 290
      GO TO 60                                                       VMS 300
50    II=I-KNC                                                       VMS 310
      A(I)=CA(II)                                                    VMS 320
60    CONTINUE                                                       VMS 330
      GO TO 80                                                       VMS 340
70    II=MM+M-1                                                      VMS 350
      BASE=A(II)                                                     VMS 360
      KK=0                                                           VMS 370
      L=L+1                                                          VMS 380
      M=M+1                                                          VMS 390
      GO TO 40                                                       VMS 400
80    CONTINUE                                                       VMS 410
      RETURN                                                         VMS 420
      END                                                            VMS 430-


      OVERLAY (LEVSP,1,0)                                            GEO  10
      PROGRAM GEOM                                                   GEO  20
C     DEFINES THE WING AND FREE ELEMENT GEOMETRY                     GEO  30
C     MAXIMUM VALUES                                                 GEO  40
C     ** NCW = 9                                                     GEO  50
C     ** NNCW = NCW+1 = 10                                           GEO  60
C     ** NSW = 20                                                    GEO  70
C     ** NSW1 = NSW-1 = 19                                           GEO  80
C     ** NWNG = NNCW*NSW1 = 190                                      GEO  90
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C      ** NCPTTL = (NNCW+1)*NSW1 = 209                                  GEO 100
       COMMON XXL(2),XXT(2),YL(2),CPCWL(10),CPCW1(10),SI(10),SN(10),SNN(1GEO 110
      10),SWP(50),SLOPE(50),XL(2,10),C(19),THETP(19),CONS(19),CPSW1(19),XGEO 120
      2LM(19),XTM(19),YLM(19),CTT(19),CPSWL(20),XLE(20),XTE(20),YLE(20),XGEO 130
      3AVWNG(190),YAVWNG(190),XN(190,2),YN(190,2),XCP(209),YCP(209),X(10,GEO 140
      420),Y(10,20)                                                     GEO 150
       COMMON /ALLRB/ AXX(210),ZMIN,NELM(11),NNELM(12),IST              GEO 160
       COMMON /LEFLP/ YLEF(10,2),XNF(10),YNF(10),ZNF(10),XLF(10,4),     GEO 170
      1YLF(10,4),SLP1(10),SS,CS,ITERS,ZBDYV(200),ZBDY(200)              GEO 180
      2,CUPV(10),CHND(10),SZBDYV(200)                                   GEO 190
       COMMON /ALLI/ NSW,NSW1,NCW,NWNG,NCPTTL,MITER,IPUNCH              GEO 200
       COMMON /ALLRA/ TTL(16),ALPHA,SINA,COSA,SWPLE,BETA,BETA2,TANPH1,B2PGEO 210
      1H1,BSQD4P,D4,CON,PI,D4SQ2,CBAR,HALFB,AREA                        GEO 220
       COMMON /MDFAV/ FYP(40,2,2),FZP(40,2,2)                           GEO 230
       COMMON /XSTN/ XBRR(25),NBRR                                      GEO 240
       COMMON /COEFF/ CL,FZMINS(10),FHS(2,10),RATIOS(2,10),             GEO 250
      1CFCORE(2,10),RATIOC(2,10)                                        GEO 260
       COMMON /LOC/ FU1,FU2,XEND,PXL(5),PXT(5),PYL(5)                   GEO 270
       COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC               GEO 280
       COMMON /GENCF/ M1(5),NW(2),YBREAK(5),CH(90),SJ(31,3),MJW1(2),    GEO 290
      1MJW2(2),WIDTH(5),SWEEP(60),NTS,NC                                GEO 300
       COMMON /NCTT/ NCT,NCON,NBT,NCOR(15),KU1,NFSH(15),KUC             GEO 310
       COMMON /ABC/ AX(1860),NMAX,NNMAX,NCONTS                          GEO 320
       COMMON /LANDA/ FGMA1,FBDA1,FGMA,CLS                              GEO 330
       COMMON /TIPVX/ XTIP(15,30),YTIP(15,30),ZTIP(15,30),NTLM(15),NTMAX GEO 340
       COMMON/CAMB/ ICAM,IM(10),XT(10,21),AAM(10,20),BBM(10,20),        GEO 350
      1CCM(10,20),DDM(10,20),YT(10),ZBDX(200),ZBDXV(200)                GEO 360
       COMMON /SHPLE/ NLE,YSL(15),AQL(14),BQL(14),CQL(14),DQL(14)       GEO 370
       COMMON /SHPTE/ NTE,YST(15),AQT(14),BQT(14),CQT(14),DQT(14)       GEO 380
       DIMENSION CPCWR(15),AW(201),CA(201),BA(15)                       GEO 390
       THEND=5HEND                                                      GEO 400
C   ***TITLE OF THE CASE TO BE RUN                                      GEO 410
       READ (5,490) TTL                                                 GEO 420
       IF (TTL(1).EQ.THEND) GO TO 390                                   GEO 430
C   ***NCW = NUMBER OF BOUND ELEMENTS IN IN THE CHORDWISE DIRECTION     GEO 440
C      M(I) = NUMBER OF STRIPS IN EACH SPANWISE SECTION PLUS ONE        GEO 450
C      NC = NUMBER OF SPANWISE SECTIONS                                 GEO 460
C      NCONTS = 0, ITERS = 0, INITIAL LOCATIONS OF FREE ELEMENTS WILL BE GEO 470
C      CALCULATED IN THE PROGRAM                                        GEO 480
C      NCONTS = 1, ITERS = 3, INITIAL LOCATIONS OF FREE ELEMENTS WILL BE GEO 490
C      READ FROM DATA CARDS                                             GEO 500
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C       ITRAKE = 1, ONE VORTEX CORE SYSTEM                                GEO 510
C       ITRAKE = 2, TWO VORTEX CORE SYSTEM                                GEO 520
C       ISPAN = 0, LEADING-EDGE VORTEX SYSTEM START FROM LINE OF SYMMETRY GEO 530
C       ISPAN = 1, LEADING-EDGE VORTEX SYSTEM START FROM OUTBOARD SECTION GEO 540
        READ (5,520) NCW,NBRR,NCONTS,MITER,IPUNCH,KU1                     GEO 550
        READ (5,520) NC,(M1(I),I=1,NC),ICAM,IST,ITERS                     GEO 560
        READ (5,520) ISPAN,ITRAKE                                         GEO 570
        NTS=0                                                             GEO 580
        DO 10 I=1,NC                                                      GEO 590
        NTS=NTS+M1(I)-1                                                   GEO 600
10      CONTINUE                                                          GEO 610
        NSW1=NTS                                                          GEO 620
        NSW=NTS+1                                                         GEO 630
        IF (ISPAN.EQ.0) GO TO 20                                          GEO 640
        MAXW=NSW-(M1(1)-1)                                                GEO 650
        MAXL=NSW1-(M1(1)-1)                                               GEO 660
        GO TO 30                                                          GEO 670
20      MAXL=NSW1                                                         GEO 680
        MAXW=NSW                                                          GEO 690
30      CONTINUE                                                          GEO 700
C     ***ALPHA AND AMACH ARE ANGLE OF ATTACK AND FREE FREE STREAM MACH NO GEO 710
C       DELTA IS THE LENGTH OF A LEADING-EDGE FREE VORTEX SEGMENT         GEO 720
C       DL IS LENGTH OF A SEGMENT OF WAKE ELEMENTS                        GEO 730
C       CBAR AND AREA ARE REFERENCE CHORD AND TOTAL REFERENCE WING AREA   GEO 740
C       NFSH(I) = NUMBER OF SEGMENTS ALONG EACG VORTEX ELEMENT ON FREE    GEO 750
C       VORTEX SHEET                                                      GEO 760
        READ (5,510) ALPHA,AMACH,DELTA,DL,XEND,CBAR,AREA,CLS              GEO 770
        READ (5,520) (NFSH(I),I=1,NSW1)                                   GEO 780
        DO 40 I=1,NSW1                                                    GEO 790
        NCOR(I)=NFSH(I)+6                                                 GEO 800
40      CONTINUE                                                          GEO 810
        READ (5,510) (XBRR(I),I=1,NBRR)                                   GEO 820
        READ (5,510) (CTT(I),I=1,NSW1)                                    GEO 830
        WRITE (6,530) TTL                                                 GEO 840
        WRITE (6,520) NCW,NBRR,NCONTS,MITER,IPUNCH,KU1                    GEO 850
        WRITE (6,520) NC,(M1(I),I=1,NC),ICAM,IST,ITERS                    GEO 860
        WRITE (6,520) ISPAN,ITRAKE                                        GEO 870
        WRITE (6,510) ALPHA,AMACH,DELTA,DL,XEND,CBAR,AREA,CLS             GEO 880
        WRITE (6,520) (NFSH(I),I=1,NSW1)                                  GEO 890
        WRITE (6,510) (XBRR(I),I=1,NBRR)                                  GEO 900
        WRITE (6,510) (CTT(I),I=1,NSW1)                                   GEO 910
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      SS=SIND(ALPHA)                                                    GEO 920
      CS=COSD(ALPHA)                                                    GEO 930
C   ***YT(I) IS Y-STATION AT WHICH CAMBER ORDINATES ARE READ IN         GEO 940
C     XNUM  IS NUMBER OF CAMBER ORDINATES TO BE READ IN. (LIMITED TO 21)GEO 950
C     CURV(I) = 0.  IF CAMBER IS TO BE FORMED BY CONNECTING STRAIGHT    GEO 960
C     SEGMENTS, WITH FIRST SEGMENT BEING REGARDED AS FLAT  L.E. FLAP    GEO 970
C     CURV(I) = 1.  IF CUBIC SPLINE INTERPOLATION IS USED               GEO 980
C     CURV(I) = 2.  IF CUBIC SPLINE INTERPOLATION IS USED , WITH        GEO 990
C     FIRST SEGMENT BEING FLAT LEADING-EDGE FLAP                        GEO1000
C     CHND(I)  IS CHORD LENGTH AT YT(I) STATION                         GEO1010
C     ICAM = 0 FLAT WING                                                GEO1020
C     ICAM = 1 CAMBER ORDINATES TO BE READ IN                           GEO1030
C     ICAM = 2 CAMBER ORDINATES TO BE DEFINED ANALYTICALLY              GEO1040
C     ICAM = 3 PLANE WITH L.E. FLAPS                                    GEO1050
      IF (ICAM.NE.1) GO TO 100                                          GEO1060
      DO 90 I=1,IST                                                     GEO1070
      READ (5,510) YT(I),XNUM,CURV(I),CHND(I)                           GEO1080
      WRITE (6,510) YT(I),XNUM,CURV(I),CHND(I)                          GEO1090
      IM(I)=XNUM                                                        GEO1100
      IR=IM(I)                                                          GEO1110
      ICV=CURV(I)                                                       GEO1120
C   ***XT(I,J)  X/C VALUES AT WHICH CAMBER ORDINATES ARE READ IN FOR    GEO1130
C     YT(I) STATION                                                     GEO1140
C     CA(J)  Z/C VALUFS IF CAMBER ORDINATES AT THE CORRESPONDING        GEO1150
C     XT(I,J) LOCATIONS                                                 GEO1160
      READ (5,510) (XT(I,J),J=1,IR)                                     GEO1170
      WRITE (6,510) (XT(I,J),J=1,IR)                                    GEO1180
      READ (5,510) (CA(J),J=1,IR)                                       GEO1190
      WRITE (6,510) (CA(J),J=1,IR)                                      GEO1200
      DO 50 K=1,IR                                                      GEO1210
50    AW(K)=XT(I,K)                                                     GEO1220
      IF (ICV.EQ.0) GO TO 60                                            GEO1230
      CALL SPLINE (IR,AW,CA,AAM,BBM,CCM,DDM)                            GEO1240
      GO TO 90                                                          GEO1250
60    DO 80 J=2,IR                                                      GEO1260
      AAM(I,J-1)=0.                                                     GEO1270
      BBM(I,J-1)=0.                                                     GEO1280
      IF (ABS(AW(J)-AW(J-1)).LE.1.E-20) GO TO 70                        GEO1290
      CCM(I,J-1)=(CA(J)-CA(J-1))/(AW(J)-AW(J-1))                        GEO1300
70    DDM(I,J-1)=CA(J-1)                                                GEO1310
80    CONTINUE                                                          GEO1320
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90    CONTINUE                                                          GE01330
100   CONTINUE                                                          GE01340
      IF (ICAM.NE.3) GO TO 120                                          GE01350
C  ***YLEF(I,1) = EXTREME INBOARD Y-COORDINATE OF A L.E. FLAP           GE01360
C     YLEF(I,2) = EXTREME OUTBOARD Y-COORDINATE OF A L.E. FLAP          GE01370
C     X1,Y1,Z1, ETC. ARE CORNER POINT COORDINATES OF A L.E. FLAP INPUT  GE01380
C     IN CLOCKWISE ORDER, FIRST FROM THE MOST INBOARD POINT.            GE01390
      DO 110 I=1,IST                                                    GE01400
      READ (5,510) (YLEF(I,K),K=1,2)                                    GE01410
      WRITE (6,510) (YLEF(I,K),K=1,2)                                   GE01420
      READ (5,510) XLF(I,1),YLF(I,1),Z1,XLF(I,2),YLF(I,2),Z2            GE01430
      WRITE (6,510) XLF(I,1),YLF(I,1),Z1,XLF(I,2),YLF(I,2),Z2           GE01440
      READ (5,510) XLF(I,3),YLF(I,3),Z3,XLF(I,4),YLF(I,4),Z4            GE01450
      WRITE (6,510) XLF(I,3),YLF(I,3),Z3,XLF(I,4),YLF(I,4),Z4           GE01460
      IF (ABS(XLF(I,4)-XLF(I,1)).GT.1.E-18) SLP1(I)=(YLF(I,4)-YLF(I,1))/GE01470
     1(XLF(I,4)-XLF(I,1))                                               GE01480
      IF (ABS(XLF(I,4)-XLF(I,1)).LE.1.E-18) SLP1(I)=1.E18               GE01490
      XNF(I)=(YLF(I,4)-YLF(I,1))*(Z3-Z2)-(YLF(I,3)-YLF(I,2))*(Z4-Z1)    GE01500
      YNF(I)=(XLF(I,3)-XLF(I,2))*(Z4-Z1)-(XLF(I,4)-XLF(I,1))*(Z3-Z2)    GE01510
      ZNF(I)=(XLF(I,4)-XLF(I,1))*(YLF(I,3)-YLF(I,2))-(XLF(I,3)-XLF(I,2))GE01520
     1*(YLF(I,4)-YLF(I,1))                                              GE01530
      IF (ABS(ZNF(I)).GT.1.E-3) GO TO 110                               GE01540
      XNF(I)=(YLF(I,4)-YLF(I,1))*(Z2-Z1)-(YLF(I,2)-YLF(I,1))*(Z4-Z1)    GE01550
      YNF(I)=(XLF(I,2)-XLF(I,1))*(Z4-Z1)-(XLF(I,4)-XLF(I,1))*(Z2-Z1)    GE01560
      ZNF(I)=(XLF(I,4)-XLF(I,1))*(YLF(I,2)-YLF(I,1))-(XLF(I,2)-XLF(I,1))GE01570
     1*(YLF(I,4)-YLF(I,1))                                              GE01580
110   CONTINUE                                                          GE01590
120   CONTINUE                                                          GE01600
      IF (ICAM.EQ.0) IST=1                                              GE01610
      NNCW=NCW                                                          GE01620
      NCW=NNCW+1                                                        GE01630
C     NPRCY=0, USED FOR BOUND ELEMENTS = (NCW+1)                        GE01640
C     NPRCY=1, USED FOR BOUND ELEMENTS = NCW                            GE01650
      NPRCY=0                                                           GE01660
130   IF (NPRCY.EQ.1) NCW=NNCW                                          GE01670
      PI=3.14159265                                                     GE01680
      FN2=2*NCW                                                         GE01690
      PIJ=PI/FLOAT(NCW)                                                 GE01700
      TWOPI=2.*PI                                                       GE01710
      DO 140 I=1,NCW                                                    GE01720
      CPCWL(I)=50.*(1.-COS((2.*FLOAT(I)-1.)*PI/FN2))                    GE01730
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      CPCWL(I)=50.*(1.-COS(FLOAT(I)*PI/FLOAT(NCW)))                     GE01740
      CC=CPCWL(I)/100.                                                  GE01750
      SNN(I)=2.*SQRT(CC*(1.-CC))                                        GE01760
      PSIJ=(2.*FLOAT(I)-1.)*PIJ/2.                                      GE01770
      SN(I)=SIN(PSIJ)/TWOPI                                             GE01780
140   SI(I)=TWOPI*SN(I)                                                 GE01790
      NCS=0                                                             GE01800
      IPANEL=1                                                          GE01810
      DO 260 KK=1,NC                                                    GE01820
      WRITE (6,400) KK                                                  GE01830
C  ***XXL(I),XXT(I),YL(I)  DEFINE THE LEADING-EDGE AND TRAILING-EDGE    GE01840
C     LOCATIONS OF THE ROOT AND  TIP CHORDS IN EACH SPANWISE SECTION    GE01850
      READ (5,510) (XXL(I),XXT(I),YL(I),I=1,2)                          GE01870
      WRITE (6,510) (XXL(I),XXT(I),YL(I),I=1,2)                         GE01880
      ISC=1                                                             GE01890
C     IF ISC=1, SKIP THE FOLLOWING INPUT DATA                           GE01920
      IF (ISC.EQ.1) GO TO 200                                           GE01930
C  ***NLE= NUMBER OF INPUT POINTS TO DEFINE THE L.E. LIMITED TO 15      GE01940
C     NTE= NUMBER OF INPUT POINTS TO DEFINE THE T.E. LIMITED TO 15      GE01950
C     MCVL=1 IF THE CUBIC SPLINE IS USED TO INTERPOLATE THE L.E. SHAPE  GE01960
C     MCVL=0 IF STRAIGHT SEGMENTS ARE ASSUMED FOR THE L.E. SHAPE        GE01970
C     MCVT=1 IF THE CUBIC SPLINE IS USED TO INTERPOLATE THE T.E. SHAPE  GE01980
C     MCVT=0 IF STRAIGHT SEGMENTS ARE ASSUMED FOR THE T.E. SHAPE        GE01990
      READ (5,520) NLE,NTE,MCVL,MCVT                                    GE02000
      WRITE (6,520) NLE,NTE,MCVL,MCVT                                   GE02010
C  ***BA,YSL = X- AND Y- COORDINATES OF INPUT POINTS TO DEFINE THE L.E. GE02020
C     SHAPE RELATIVE TO THE L.E. OF INBOARD CHORD                       GE02030
      READ (5,510) (BA(I),I=1,NLE)                                      GE02040
      WRITE (6,510) (BA(I),I=1,NLE)                                     GE02050
      READ (5,510) (YSL(I),I=1,NLE)                                     GE02060
      WRITE (6,510) (YSL(I),I=1,NLE)                                    GE02070
      IF (MCVL.EQ.0) GO TO 150                                          GE02080
      CALL SPLINE (NLE,YSL,BA,AQL,BQL,CQL,DQL)                          GE02090
      GO TO 170                                                         GE02100
150   DO 160 I=2,NLE                                                    GE02110
      AQL(I-1)=0.                                                       GE02120
      BQL(I-1)=0.                                                       GE02130
      CQL(I-1)=(BA(I)-BA(I-1))/(YSL(I)-YSL(I-1))                        GE02140
160   DQL(I-1)=BA(I-1)                                                  GE02150
C  ***BA,YST = X- ANS Y- COORDINATES OF INPUT POINTS TO DEFINE THE T.E. GE02160
C     SHAPE RELATIVE TO THE T.E. OF INBOARD CHORD                       GE02170
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170   CONTINUE                                                          GE02180
      READ (5,510) (BA(I),I=1,NTE)                                      GE02190
      WRITE (6,510) (BA(I),I=1,NTE)                                     GE02200
      READ (5,510) (YST(I),I=1,NTE)                                     GE02210
      WRITE (6,510) (YST(I),I=1,NTE)                                    GE02220
      IF (MCVT.EQ.0) GO TO 180                                          GE02230
      CALL SPLINE (NTE,YST,BA,AQT,BQT,CQT,DQT)                          GE02240
      GO TO 200                                                         GE02250
180   DO 190 I=2,NTE                                                    GE02260
      AQT(I-1)=0.                                                       GE02270
      BQT(I-1)=0.                                                       GE02280
      CQT(I-1)=(BA(I)-BA(I-1))/(YST(I)-YST(I-1))                        GE02290
190   DQT(I-1)=BA(I-1)                                                  GE02300
200   CONTINUE                                                          GE02310
      YBREAK(KK)=YL(2)                                                  GE02320
      XBRR(20+KK)=ATAN((XXL(2)-XXL(1))/(YL(2)-YL(1)))                   GE02330
      PXL(KK)=XXL(1)                                                    GE02340
      PXL(KK+1)=XXL(2)                                                  GE02350
      PXT(KK)=XXT(1)                                                    GE02360
      PXT(KK+1)=XXT(2)                                                  GE02370
      PYL(KK)=YL(1)                                                     GE02380
      PYL(KK+1)=YL(2)                                                   GE02390
      FM=M1(KK)                                                         GE02400
      NSW=M1(KK)                                                        GE02410
      NSW1=NSW-1                                                        GE02420
      DO 210 J=1,NSW                                                    GE02430
      FJ=FLOAT(J)*2.                                                    GE02440
210   CPSWL(J)=50.*(1.-COS((FJ-1.)*PI/(2.*FM)))                         GE02450
      DO 220 I=1,NSW1                                                   GE02460
      FI=I                                                              GE02470
220   CPSW1(I)=50.*(1.-COS(FI*PI/FLOAT(NSW)))                           GE02480
      IF (KK.EQ.NC) GO TO 230                                           GE02490
      CPSWL(1)=0.                                                       GE02500
      CPSWL(NSW)=100.                                                   GE02510
      GO TO 240                                                         GE02520
230   CPSWL(1)=0.                                                       GE02530
      IF ((XXT(2)-XXL(2)).NE.0.) CPSWL(NSW)=100.                        GE02540
240   CONTINUE                                                          GE02550
      CALL PNLWNG (NSW,IPANEL,LPANEL,NCW,NCS,NTS,NC,KK,ISC)             GE02560
      IPANEL=LPANEL+1                                                   GE02570
      NCS=NCS+NSW-1                                                     GE02580
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      WIDTH(KK)=YL(2)-YL(1)                                             GE02590
      IF (KK.NE.NC) GO TO 260                                           GE02600
      HALFB=PYL(NC+1)                                                   GE02610
      DO 250 I=1,NTS                                                    GE02620
      CH(I)=XTM(I)-XLM(I)                                               GE02630
      C(I)=CH(I)                                                        GE02640
      YYLM=YLM(I)/HALFB                                                 GE02650
250   THETP(I)=ARCOS(YYLM)                                              GE02660
260   CONTINUE                                                          GE02670
      NCPTTL=NTS+LPANEL                                                 GE02680
      NWNG=LPANEL                                                       GE02690
      IF (NPRCY.EQ.1) GO TO 290                                         GE02700
      NCW1=NCW                                                          GE02710
      REWIND 1                                                          GE02720
      REWIND 7                                                          GE02730
      WRITE (1) NCW,NWNG                                                GE02740
      WRITE (1) (SI(I),SNN(I),I=1,NCW)                                  GE02750
      N2=NCW*NC                                                         GE02760
      WRITE (1) (SWP(I),I=1,N2)                                         GE02770
      WRITE (1) (XAVWNG(I),YAVWNG(I),I=1,NWNG,NCW)                      GE02780
      DO 270 I=1,NCW                                                    GE02790
270   CPCWR(I)=CPCWL(I)/100.                                            GE02800
      WRITE (6,430)                                                     GE02810
      WRITE (6,440)                                                     GE02820
      NSW1=NTS                                                          GE02830
      NSW=NTS+1                                                         GE02840
      CALL CAMBER (NPRCY,C,XCP,YCP,XN,YN,XLM,YLM,XAVWNG,YAVWNG)         GE02850
      DO 280 I=1,NSW1                                                   GE02860
      DO 280 J=1,NCW                                                    GE02870
      IJ=(I-1)*NCW+J                                                    GE02880
      WRITE (6,510) ZBDXV(IJ),ZBDYV(IJ)                                 GE02890
280   CONTINUE                                                          GE02900
      NPRCY=1                                                           GE02910
      GO TO 130                                                         GE02920
290   DO 300 I=1,NCW                                                    GE02930
      CPCWL(I)=CPCWL(I)/100.                                            GE02940
300   CPCW1(I)=CPCW1(I)/100.                                            GE02950
      NSW1=NTS                                                          GE02960
      NSW=NTS+1                                                         GE02970
      WRITE (6,450)                                                     GE02980
      CALL CAMBER (NPRCY,C,XCP,YCP,XN,YN,XLM,YLM,XAVWNG,YAVWNG)         GE02990
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      CALL CAMBER (2,C,XCP,YCP,XN,YN,XLM,YLM,XAVWNG,YAVWNG)          GE03000
      WRITE (6,460)                                                  GE03010
      DO 310 I=1,NSW1                                                GE03020
      DO 310 J=1,NCW                                                 GE03030
      IJ=(I-1)*NCW+J                                                 GE03040
      WRITE (6,510) ZBDX(IJ),ZBDY(IJ),SZBDYV(IJ)                     GE03050
310   CONTINUE                                                       GE03060
      WRITE (6,470)                                                  GE03070
      WRITE (6,480)                                                  GE03080
      DO 320 I=1,NSW1                                                GE03090
      IJ=NWNG+I                                                      GE03100
      WRITE (6,510) ZBDX(IJ),ZBDY(IJ)                                GE03110
320   CONTINUE                                                       GE03120
C     EVALUATING THE CONSTANTS                                       GE03130
      ALPHA=ALPHA*PI/180.                                            GE03140
      TANPH1=TAN(ALPHA)                                              GE03150
      TANPH2=TANPH1*TANPH1                                           GE03160
      BETA2=1.-AMACH*AMACH                                           GE03170
      BETA=SQRT(BETA2)                                               GE03180
      B2PH1=BETA2*TANPH1                                             GE03190
      D4=BETA2*TANPH2+1.                                             GE03200
      D4SQ2=2.*SQRT(D4)                                              GE03210
      CON=BETA2/(8.*FLOAT(NCW))                                      GE03220
      BSQD4P=BETA2/(4.*PI)                                           GE03230
      DO 330 I=1,NC                                                  GE03240
      SWPLE=XBRR(20+I)                                               GE03250
      CON1=COS(SWPLE)                                                GE03260
      CON2=(SIN(SWPLE))/CON1                                         GE03270
      CON3=FLOAT(NCW)*SQRT(BETA2+CON2*CON2)                          GE03280
      CON4=2.*CON1/(PI*SQRT(1.-AMACH*AMACH*CON1*CON1))               GE03290
      AW(I)=CON3                                                     GE03300
      CA(I)=CON4                                                     GE03310
330   CONTINUE                                                       GE03320
      N1=0                                                           GE03330
      DO 350 KI=1,NC                                                 GE03340
      N2=N1+M1(KI)-1                                                 GE03350
      II=N1+1                                                        GE03360
      DO 340 I=II,N2                                                 GE03370
340   CTT(I)=AW(KI)*SQRT(CA(KI)*CTT(I))                              GE03380
      N1=N2                                                          GE03390
350   CONTINUE                                                       GE03400
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      DO 360 I=1,NSW1                                                   GE03410
360   CONS(I)=CON*C(I)                                                  GE03420
      SINA=SIN(ALPHA)                                                   GE03430
      COSA=COS(ALPHA)                                                   GE03440
      DO 370 I=1,NSW                                                    GE03450
370   CPSWL(I)=YLE(I)/PYL(NC+1)                                         GE03460
      DO 380 I=1,NSW1                                                   GE03470
380   CPSW1(I)=YLM(I)/PYL(NC+1)                                         GE03480
      WRITE (1) (SNN(I),I=1,NCW)                                        GE03490
      N2=NCW*NC                                                         GE03500
      WRITE (1) (SWP(I),I=1,N2)                                         GE03510
      WRITE (1) (XAVWNG(I),YAVWNG(I),I=1,NWNG)                          GE03520
      WRITE (1) (C(I),I=1,NSW1)                                         GE03530
      WRITE (1) (THETP(I),I=1,NSW1)                                     GE03540
      WRITE (1) (XTE(I),XLE(I),YLE(I),I=1,NSW)                          GE03550
      WRITE (1) (XLM(I),YLM(I),I=1,NSW1)                                GE03560
      WRITE (1) (CONS(I),I=1,NSW1)                                      GE03570
      WRITE (1) (SI(I),SN(I),I=1,NCW)                                   GE03580
      WRITE (1) (XCP(I),YCP(I),I=1,NCPTTL)                              GE03590
      WRITE (1) ((XN(I,J),YN(I,J),J=1,2),I=1,NWNG)                      GE03600
      WRITE (1) (CTT(I),I=1,NSW1)                                       GE03610
      WRITE (1) (CPCWL(I),I=1,NCW)                                      GE03620
      WRITE (1) (CPCW1(I),I=1,NCW)                                      GE03630
      WRITE (1) (CPSWL(I),I=1,NSW)                                      GE03640
      WRITE (1) (CPSW1(I),I=1,NSW1)                                     GE03650
      IF ((PXT(NC+1)-PXL(NC+1)).NE.0.) MAXW=NTS                         GE03660
      CALL FRELM (XXL,XXT,YL,XLE,XTE,YLE,PI,NCW1,NSW1,XEND,DELTA,ALPHA,DGE03670
     1L,CPCWL)                                                          GE03680
      RETURN                                                            GE03690
390   WRITE (6,500)                                                     GE03700
      STOP                                                              GE03710
C                                                                       GE03730
400   FORMAT (29H  SAPNWISE SECTION OF NUMBER ,2X,I2)                   GE03740
430   FORMAT (1H0,40H CAMBER SLOPE AT FINE GRID BOUND ELEMENT)          GE03770
440   FORMAT (1H0,3X,5HDZDXV,5X,5HDZDYV)                                GE03780
450   FORMAT (1H0,42H CAMBER SLOPE AT COARSE GRID BOUND ELEMENT)        GE03790
460   FORMAT (1H0,3X,4HDZDX,7X,4HDZDY,5X,5HDZDYV)                       GE03800
470   FORMAT (1H0,48H CAMBER SLOPE AT THE LEADING EDGE CONTROL POINTS)  GE03810
480   FORMAT (1H0,3X,4HDZDX,7X,4HDZDY)                                  GE03820
490   FORMAT (16A5)                                                     GE03830
500   FORMAT (1H1,/,10X,19HALL CASES COMPLETED)                         GE03840
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510   FORMAT (8F10.5)                                                  GE03850
520   FORMAT (10I5)                                                    GE03860
530   FORMAT (1H1,/,17H INPUT DATA CARDS/,16A5)                        GE03870
      END                                                              GE03880-


      SUBROUTINE PNLWNG (NSW,IPANEL,LPANEL,NCW,NCS,NTS,NC,KI,ISC)      PNG  10
C     GENERATES THE GRID OF BOUND AND TRAILING VORTEX ELEMENTS         PNG  20
      COMMON XXL(2),XXT(2),YL(2),CPCWL(10),CPCW1(10),SI(10),SN(10),SNN(1PNG  30
     10),SWP(50),SLOPE(50),XL(2,10),C(19),THETP(19),CONS(19),CPSW1(19),XPNG  40
     2LM(19),XTM(19),YLM(19),CTT(19),CPSWL(20),XLE(20),XTE(20),YLE(20),XPNG  50
     3AVWNG(190),YAVWNG(190),XN(190,2),YN(190,2),XCP(209),YCP(209),X(10,PNG  60
     420),Y(10,20)                                                     PNG  70
      IF (ISC.NE.1) GO TO 80                                           PNG  80
C     STRAIGHT LEADING-EDGE COMPUTATION                                PNG  90
      DO 10 I=1,2                                                      PNG 100
      D=XXT(I)-XXL(I)                                                  PNG 110
      DO 10 J=1,NCW                                                    PNG 120
10    XL(I,J)=XXL(I)+CPCWL(J)*D/100.                                   PNG 130
      SPAN=YL(2)-YL(1)                                                 PNG 140
      DO 20 I=1,NCW                                                    PNG 150
      II=(KI-1)*NCW+I                                                  PNG 160
      SLOPE(II)=(XL(2,I)-XL(1,I))/SPAN                                 PNG 170
20    SWP(II)=ATAN(SLOPE(II))                                          PNG 180
      DO 30 I=1,NCW                                                    PNG 190
      II=(KI-1)*NCW+I                                                  PNG 200
30    CONTINUE                                                         PNG 210
      DO 40 K=1,NSW                                                    PNG 220
      YK=CPSWL(K)*SPAN/100.                                            PNG 230
      YL1=YL(1)+YK                                                     PNG 240
      DO 40 J=1,NCW                                                    PNG 250
      JJ=(KI-1)*NCW+J                                                  PNG 260
      Y(J,K)=YL1                                                       PNG 270
40    X(J,K)=XL(1,J)+SLOPE(JJ)*YK                                      PNG 280
      NSW1=NSW-1                                                       PNG 290
      IF (NC.EQ.1) GO TO 50                                            PNG 300
      IF (KI.NE.1) GO TO 60                                            PNG 310
50    CONTINUE                                                         PNG 320
      XLE(1)=XXL(1)                                                    PNG 330
      XTE(1)=XXT(1)                                                    PNG 340
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      YLF(1)=YL(1)                                                      PNG 350
60    CONTINUE                                                          PNG 360
      X1=XXL(1)                                                         PNG 370
      X2=XXT(1)                                                         PNG 380
      DLE=(XXL(2)-XXL(1))/SPAN                                          PNG 390
      DTE=(XXT(2)-XXT(1))/SPAN                                          PNG 400
      DO 70 I=2,NSW                                                     PNG 410
      II=NCS+I                                                          PNG 420
      YLE(II)=Y(1,I)                                                    PNG 430
      YLM(II-1)=YL(1)+CPSW1(I-1)*SPAN/100.                              PNG 440
      DLEL=DLE*(Y(1,I)-Y(1,I-1))                                        PNG 450
      DTET=DTE*(Y(1,I)-Y(1,I-1))                                        PNG 460
      XLE(II)=XLE(II-1)+DLEL                                            PNG 470
      XTE(II)=XTE(II-1)+DTET                                            PNG 480
      XLM(II-1)=X1+SPAN*CPSW1(I-1)*DLE/100.                             PNG 490
70    XTM(II-1)=X2+SPAN*CPSW1(I-1)*DTE/100.                             PNG 500
      GO TO 110                                                         PNG 510
C     CURVED LEADING-EDGE COMPUTATION                                   PNG 520
80    SPAN=YL(2)-YL(1)                                                  PNG 530
      DO 90 K=1,NSW                                                     PNG 540
      II=NCS+K                                                          PNG 550
      YK=CPSWL(K)*SPAN/100.                                             PNG 560
      YC=YL(1)+YK                                                       PNG 570
      XLE(II)=SHAPLE(YK)+XXL(1)                                         PNG 580
      XTE(II)=SHAPTE(YK)+XXT(1)                                         PNG 590
      YLE(II)=YC                                                        PNG 600
      CHD=XTE(II)-XLE(II)                                               PNG 610
      DO 90 J=1,NCW                                                     PNG 620
      Y(J,K)=YC                                                         PNG 630
      X(J,K)=XLE(II)+CPCWL(J)*CHD/100.                                  PNG 640
90    CONTINUE                                                          PNG 650
      NSW1=NSW-1                                                        PNG 660
      DO 100 I=1,NSW1                                                   PNG 670
      II=NCS+I                                                          PNG 680
      YK1=CPSW1(I)*SPAN/100.                                            PNG 690
      YC1=YL(1)+YK1                                                     PNG 700
      XLM(II)=XXL(1)+SHAPLE(YK1)                                        PNG 710
      XTM(II)=XXT(1)+SHAPTE(YK1)                                        PNG 720
      YLM(II)=YC1                                                       PNG 730
100   CONTINUE                                                          PNG 740
110   CONTINUE                                                          PNG 750
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C     DETERMINE THE CONTROL AND VORTEX POINTS ON THE WING SURFACE        PNG 760
      DO 130 K=1,NSW1                                                    PNG 770
      KN=NCS+K                                                           PNG 780
      CC=XTM(KN)-XLM(KN)                                                 PNG 790
      DO 130 J=1,NCW                                                     PNG 800
      NPANEL=IPANEL+(K-1)*NCW+J-1                                        PNG 810
      XCP(NPANEL)=XLM(KN)+CC*CPCW1(J)/100.                               PNG 820
      YCP(NPANEL)=YLM(KN)                                                PNG 830
      XAVWNG(NPANEL)=XLM(KN)+CC*CPCWL(J)/100.                            PNG 840
      YAVWNG(NPANEL)=YLM(KN)                                             PNG 850
      DO 120 I=1,2                                                       PNG 860
      KA=K+I-1                                                           PNG 870
      XN(NPANEL,I)=X(J,KA)                                               PNG 880
120   YN(NPANEL,I)=Y(J,KA)                                               PNG 890
130   CONTINUE                                                           PNG 900
      LPANEL=NPANEL                                                      PNG 910
      IF (KI.NE.NC) RETURN                                               PNG 920
      DO 140 K=1,NTS                                                     PNG 930
      NP=LPANEL+K                                                        PNG 940
      XCP(NP)=XLM(K)                                                     PNG 950
140   YCP(NP)=YLM(K)                                                     PNG 960
      RETURN                                                             PNG 970
      END                                                                PNG 980-


      FUNCTION SHAPLE(Y)                                                 SHL  10
      COMMON /SHPLE/ NLE,YSL(15),AQL(14),BQL(14),CQL(14),DQL(14)         SHL  20
      K=1                                                                SHL  30
10    IF (Y.GE.YSL(K).AND.Y.LT.YSL(K+1)) GO TO 20                        SHL  40
      K=K+1                                                              SHL  50
      IF (K.GE.NLE) GO TO 30                                             SHL  60
      GO TO 10                                                           SHL  70
20    SM=Y-YSL(K)                                                        SHL  80
      SHAPLE=AQL(K)*SM**3+BQL(K)*SM**2+CQL(K)*SM+DQL(K)                  SHL  90
      GO TO 50                                                           SHL 100
30    IF (Y.LT.YSL(1)) GO TO 40                                          SHL 110
      K=NLE-1                                                            SHL 120
      GO TO 20                                                           SHL 130
40    K=1                                                                SHL 140
      GO TO 20                                                           SHL 150
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50    RETURN                                                            SHL 160
      END                                                               SHL 170-


      FUNCTION SHAPTE(Y)                                                SHT  10
      COMMON /SHPTE/ NTE,YST(15),AQT(14),BQT(14),CQT(14),DQT(14)        SHT  20
      K=1                                                               SHT  30
10    IF (Y.GE.YST(K).AND.Y.LT.YST(K+1)) GO TO 20                       SHT  40
      K=K+1                                                             SHT  50
      IF (K.GE.NTE) GO TO 30                                            SHT  60
      GO TO 10                                                          SHT  70
20    SM=Y-YST(K)                                                       SHT  80
      SHAPTE=AQT(K)*SM**3+BQT(K)*SM**2+CQT(K)*SM+DQT(K)                 SHT  90
      GO TO 50                                                          SHT 100
30    IF (Y.LT.YST(1)) GO TO 40                                         SHT 110
      K=NTE-1                                                           SHT 120
      GO TO 20                                                          SHT 130
40    K=1                                                               SHT 140
      GO TO 20                                                          SHT 150
50    RETURN                                                            SHT 160
      END                                                               SHT 170-


      SUBROUTINE FRELM (XXL,XXT,YL,XLE,XTE,YLE,PI,NCW1,NSW1,XEND,DELTA,AFLM  10
     1LPHA,DL,CPCWL)                                                    FLM  20
C     FINDS THE INETIAL COORDINATES OF FREE VORTEX ELEMENTS             FLM  30
      COMMON /ALLRB/ XE(40),YE(40),ZE(40),XXE(30),YYE(30),ZZE(30),ZMIN,NFLM  40
     1ELM(11),NNELM(12)                                                 FLM  50
      COMMON /XPLOT/ XMN,YMN,ZMN,XMX,YMX,ZMX                            FLM  60
      COMMON /NCTT/ NCT,NCON,NRT,NCOR(15),KU1,NFSH(15),KUC              FLM  70
      COMMON /LOC/ FU1,FU2,YEND,PXL(5),PXT(5),PYL(5)                    FLM  80
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                FLM  90
      COMMON /GENCF/ M1(5),NW(2),YBREAK(5),CH(90),SJ(31,3),MJW1(2),     FLM 100
     1MJW2(2),WIDTH(5),SWEEP(60),NTS,NC                                 FLM 110
      COMMON /CAMB/ ICAM                                                FLM 120
      COMMON /TIPVX/ XTIP(15,30),YTIP(15,30),ZTIP(15,30),NTLM(15),NTMAX FLM 130
      DIMENSION CPCWL(1)                                                FLM 140
      COMMON /ABC/ PXE(10,40),PYE(10,40),PZE(10,40),PXXE(11,20),        FLM 150
     1PYYE(11,20),PZZE(11,20),NMAX,NNMAX,NCONTS                         FLM 160
```

```
      DIMENSION XXL(1), XXT(1), YL(1), XLE(1), XTE(1), YLE(1)
      AHPI=ALPHA
      ALP=ALPHA*180./PI
      IF (ALP.LE.15.) AHPI=(22.5-0.5*ALP)*PI/180.
      NSW=NSW1+1
      THT1=PI/(FLOAT(2*NCW1))
      CPC=0.5*(1.-COS(THT1))
      ZMIN=(XTE(1)-XLE(1))*TAN(AHPI)/10.
      SAHPI=SIN(AHPI)
      CAHPI=COS(AHPI)
      REWIND 2
      REWIND 4
C     EVALUATION OF COORDINATES OF LEADING-EDGE ELEMENTS
      IF (ISPAN.EQ.0) NSW1=NTS
      IF (ISPAN.EQ.0) NSW=NTS+1
      IF (ISPAN.EQ.1) NSW1=MAXL
      IF (ISPAN.EQ.1) NSW=MAXW
      DO 40 I=1,NSW1
      IF (I.EQ.NSW1) GO TO 10
      XE(1)=XTE(I+1)
      YE(1)=YLE(I+1)
      ZE(1)=0.
      XE(2)=XLE(I+1)+CPC*(XTE(I+1)-XLE(I+1))
      YE(2)=YLE(I+1)
      ZE(2)=0.
      XE(3)=XLE(I)+CPC*(XTE(I)-XLE(I))
      YE(3)=YLE(I)
      ZE(3)=0.
      XE(4)=XLE(I)
      YE(4)=YLE(I)
      ZE(4)=0.
      XE(5)=XLE(I)-0.05*(XTE(I)-XLE(I))
      IF (I.EQ.1) XMN=XE(5)
      YE(5)=YLE(I)
      ZE(5)=0.
      XE(6)=XE(4)+0.05*(XTE(I)-XLE(I))
      YE(6)=YE(4)
      ZE(6)=ZMIN
      J=6
      XE(7)=XE(6)+DELTA*CAHPI
      YE(7)=YE(6)
```

```
      ZE(7)=ZE(6)+DELTA*SAHPI                                           FLM 580
      IF (I.EQ.1) GO TO 30                                              FLM 590
      J=7                                                               FLM 600
      GO TO 20                                                          FLM 610
10    CONTINUE                                                          FLM 620
      XE(1)=PXL(NC+1)+CPC*(PXT(NC+1)-PXL(NC+1))                         FLM 630
      YE(1)=PYL(NC+1)                                                   FLM 640
      ZE(1)=0.                                                          FLM 650
      XE(3)=XLE(I)+CPC*(XTE(I)-XLE(I))                                  FLM 660
      YE(3)=YLE(I)                                                      FLM 670
      ZE(3)=0.                                                          FLM 680
      XE(2)=0.5*(XE(1)+XE(3))                                           FLM 690
      YE(2)=0.5*(YE(1)+YE(3))                                           FLM 700
      ZE(2)=0.5*(ZE(1)+ZE(3))                                           FLM 710
      XE(4)=XLE(I)                                                      FLM 720
      YE(4)=YLE(I)                                                      FLM 730
      ZE(4)=0.                                                          FLM 740
      XE(5)=XLE(I)-0.05*(XTE(I)-XLE(I))                                 FLM 750
      YE(5)=YLE(I)                                                      FLM 760
      ZE(5)=0.                                                          FLM 770
      XE(6)=XE(4)+0.05*(XTE(I)-XLE(I))                                  FLM 780
      YE(6)=YE(4)                                                       FLM 790
      ZE(6)=ZMIN                                                        FLM 800
      XE(7)=XE(6)+DELTA*CAHPI                                           FLM 810
      YE(7)=YE(6)                                                       FLM 820
      ZE(7)=ZE(6)+DELTA*SAHPI                                           FLM 830
      J=7                                                               FLM 840
20    XE(J+1)=XE(J)+DELTA                                               FLM 850
      YE(J+1)=YE(J)                                                     FLM 860
      ZE(J+1)=ZE(J)                                                     FLM 870
      IF (XE(J+1).GE.XEND) GO TO 30                                     FLM 880
      J=J+1                                                             FLM 890
      GO TO 20                                                          FLM 900
30    NELM(I)=J+1                                                       FLM 910
      K=NELM(I)                                                         FLM 920
      IF (NCONTS.NE.0) WRITE (2) (XE(J),YE(J),ZE(J),J=1,5)              FLM 930
40    WRITE (4) K,(XE(J),YE(J),ZE(J),J=1,K)                             FLM 940
      NMAX=0                                                            FLM 950
      DO 50 I=1,NSW1                                                    FLM 960
50    IF (NMAX.LT.NELM(I)) NMAX=NELM(I)                                 FLM 970
C     EVALUATION OF COORDINATES OF WAKE ELEMENTS                        FLM 980
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```
      YGL=0.95*(YLE(NSW)-YLE(NSW1))                                     FLM 990
      DO 100 I=1,MAXW                                                   FLM1000
      XXE(1)=XTE(I)                                                     FLM1010
      YYE(1)=YLE(I)                                                     FLM1020
      ZZE(1)=0.                                                         FLM1030
      XXE(2)=XXE(1)+(PXT(1)-PXL(1))/10.                                 FLM1040
      YYE(2)=YYE(1)                                                     FLM1050
      ZZE(2)=ZZE(1)                                                     FLM1060
      XXE(3)=XXE(2)+(PXT(1)-PXL(1))/10.                                 FLM1070
      YYE(3)=YYE(2)                                                     FLM1080
      ZZE(3)=ZZE(2)                                                     FLM1090
      J=3                                                               FLM1100
      IF (I.EQ.NSW) GO TO 60                                            FLM1110
      GO TO 80                                                          FLM1120
60    CONTINUE                                                          FLM1130
      IF ((PXT(NC+1)-PXL(NC+1)).EQ.0.) GO TO 80                         FLM1140
      XXE(1)=PXL(NC+1)+CPC*(PXT(NC+1)-PXL(NC+1))                        FLM1150
      YYE(1)=PYL(NC+1)                                                  FLM1160
      ZZE(1)=0.                                                         FLM1170
      XXE(2)=XXE(1)+YGL*CAHPI                                           FLM1180
      YYE(2)=YYE(1)                                                     FLM1190
      ZZE(2)=ZZE(1)+YGL*SAHPI                                           FLM1200
      J=2                                                               FLM1210
70    IF (XXE(J).GE.XEND) GO TO 90                                      FLM1220
      XXE(J+1)=XXE(J)+DELTA*CAHPI                                       FLM1230
      YYE(J+1)=YYE(J)                                                   FLM1240
      ZZE(J+1)=ZZE(J)+DELTA*SAHPI                                       FLM1250
      J=J+1                                                             FLM1260
      GO TO 70                                                          FLM1270
80    IF (XXE(J).GE.XEND) GO TO 90                                      FLM1280
      XXE(J+1)=XXE(J)+DL                                                FLM1290
      YYE(J+1)=YYE(J)                                                   FLM1300
      ZZE(J+1)=ZZE(J)                                                   FLM1310
      J=J+1                                                             FLM1320
      GO TO 80                                                          FLM1330
90    NNELM(I)=J                                                        FLM1340
      K=J                                                               FLM1350
      IF (NCONTS.NE.0) WRITE (2) (XXE(J),YYE(J),ZZE(J),J=1,2)           FLM1360
100   WRITE (4) K,(XXE(J),YYE(J),ZZE(J),J=1,K)                          FLM1370
      NNMAX=0                                                           FLM1380
      IF ((PXT(NC+1)-PXL(NC+1)).EQ.0.) NT=MAXL                          FLM1390
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```
      IF ((PXT(NC+1)-PXL(NC+1)).NE.0.) NT=MAXW                          FLM1400
      DO 110 I=1,NT                                                     FLM1410
110   IF (NNMAX.LT.NNELM(I)) NNMAX=NNELM(I)                             FLM1420
      WRITE (4) NMAX,NNMAX,ZMIN,NCONTS                                  FLM1430
C     EVALUATION OF SIDE EDGE VORTEX ELEMENTS                           FLM1440
      NCW=NCW1-1                                                        FLM1450
      CAHPI=COS(AHPI/2.)                                                FLM1460
      SAHPI=SIN(AHPI/2.)                                                FLM1470
      IF ((PXT(NC+1)-PXL(NC+1)).EQ.0.) GO TO 180                        FLM1480
      DO 120 I=1,NCW                                                    FLM1490
      XTIP(I,1)=PXL(NC+1)+CPCWL(I)*(PXT(NC+1)-PXL(NC+1))                FLM1500
      YTIP(I,1)=PYL(NC+1)                                               FLM1510
      ZTIP(I,1)=0.                                                      FLM1520
120   CONTINUE                                                          FLM1530
      DO 150 I=1,NCW                                                    FLM1540
      FL=(PXT(NC+1)-PXL(NC+1))/2.                                       FLM1550
      J=1                                                               FLM1560
130   XTIP(I,J+1)=XTIP(I,J)+FL*CAHPI                                    FLM1570
      YTIP(I,J+1)=PYL(NC+1)+0.01                                        FLM1580
      ZTIP(I,J+1)=ZTIP(I,J)+FL*SAHPI                                    FLM1590
      IF (XTIP(I,J+1).GE.XEND) GO TO 140                                FLM1600
      IF (XTIP(I,J+1).GE.PXT(NC+1)) FL=DELTA                            FLM1610
      J=J+1                                                             FLM1620
      GO TO 130                                                         FLM1630
140   NTLM(I)=J+1                                                       FLM1640
150   CONTINUE                                                          FLM1650
      DO 160 I=1,NCW                                                    FLM1660
      KK=NTLM(I)                                                        FLM1670
      WRITE (6,280) (XTIP(I,J),J=1,KK)                                  FLM1680
      WRITE (6,280) (YTIP(I,J),J=1,KK)                                  FLM1690
      WRITE (6,280) (ZTIP(I,J),J=1,KK)                                  FLM1700
160   CONTINUE                                                          FLM1710
      NTMAX=0                                                           FLM1720
      DO 170 I=1,NCW                                                    FLM1730
      IF (NTMAX.LT.NTLM(I)) NTMAX=NTLM(I)                               FLM1740
170   CONTINUE                                                          FLM1750
180   CONTINUE                                                          FLM1760
      XLNT=XEND-XMN                                                     FLM1770
      XMX=XEND                                                          FLM1780
      XMX=XEND+0.20*XLNT                                                FLM1790
      YMN=0.                                                            FLM1800
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      YMX=PYL(NC+1)                                                     FLM1810
      ZMN=-PYL(NC+1)*0.6667                                             FLM1820
      ZMX=PYL(NC+1)*0.6667                                              FLM1830
      IF (NCONTS.EQ.0) GO TO 230                                        FLM1840
C     READS LOCATION OF LEADING-EDGE ELEMENTS FROM INPUT DATA CARDS     FLM1850
      REWIND 2                                                          FLM1860
      REWIND 4                                                          FLM1870
      READ (5,300) (NFLM(I),I=1,MAXL)                                   FLM1880
      DO 190 I=1,MAXL                                                   FLM1890
      K=NELM(I)                                                         FLM1900
      READ (5,290) ((X1,J=1,5),(XE(J),J=6,K))                           FLM1910
      READ (5,290) ((Y1,J=1,5),(YE(J),J=6,K))                           FLM1920
      READ (5,290) ((Z1,J=1,5),(ZE(J),J=6,K))                           FLM1930
      READ (2) (XE(J),YE(J),ZE(J),J=1,5)                                FLM1940
190   WRITE (4) K,(XE(J),YE(J),ZE(J),J=1,K)                             FLM1950
C     READS LOCATION OF WAKE ELEMENTS FROM INPUT DATA CARDS             FLM1960
      READ (5,300) (NNELM(I),I=1,MAXW)                                  FLM1970
      DO 200 I=1,MAXW                                                   FLM1980
      K=NNELM(I)                                                        FLM1990
      READ (5,290) ((X1,J=1,2),(XXE(J),J=3,K))                          FLM2000
      READ (5,290) ((Y1,J=1,2),(YYE(J),J=3,K))                          FLM2010
      READ (5,290) ((Z1,J=1,2),(ZZE(J),J=3,K))                          FLM2020
      READ (2) (XXE(J),YYE(J),ZZE(J),J=1,2)                             FLM2030
200   WRITE (4) K,(XXE(J),YYE(J),ZZE(J),J=1,K)                          FLM2040
      WRITE (4) NMAX,NNMAX,ZMIN,NCONTS                                  FLM2050
      IF ((PXT(NC+1)-PXL(NC+1)).EQ.0.) GO TO 220                        FLM2060
      READ (5,300) (NTLM(I),I=1,NCW)                                    FLM2070
      DO 210 I=1,NCW                                                    FLM2080
      K=NTLM(I)                                                         FLM2090
      READ (5,290) (XTIP(I,J),J=1,K)                                    FLM2100
      READ (5,290) (YTIP(I,J),J=1,K)                                    FLM2110
      READ (5,290) (ZTIP(I,J),J=1,K)                                    FLM2120
210   CONTINUE                                                          FLM2130
220   CONTINUE                                                          FLM2140
230   WRITE (6,310)                                                     FLM2150
      REWIND 4                                                          FLM2160
      DO 250 I=1,MAXL                                                   FLM2170
      READ (4) K,(XE(J),YE(J),ZE(J),J=1,K)                              FLM2180
      DO 240 J=1,K                                                      FLM2190
      PXE(I,J)=XE(J)                                                    FLM2200
      PYE(I,J)=YE(J)                                                    FLM2210
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      PZE(I,J)=ZE(J)                                                    FLM2220
240   CONTINUE                                                          FLM2230
250   CONTINUE                                                          FLM2240
      DO 270 I=1,MAXW                                                   FLM2250
      READ (4) K,(XXE(J),YYE(J),ZZE(J),J=1,K)                           FLM2260
      DO 260 J=1,K                                                      FLM2270
      PXXE(I,J)=XXE(J)                                                  FLM2280
      PYYE(I,J)=YYE(J)                                                  FLM2290
      PZZE(I,J)=ZZE(J)                                                  FLM2300
260   CONTINUE                                                          FLM2310
270   CONTINUE                                                          FLM2320
      RETURN                                                            FLM2330
C                                                                       FLM2340
280   FORMAT (1H0,5X,8F10.5)                                            FLM2360
290   FORMAT (8F10.4)                                                   FLM2370
300   FORMAT (10I2)                                                     FLM2380
310   FORMAT (18H END OF INPUT DATA,//)                                 FLM2390
      END                                                               FLM2400-
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      SUBROUTINE SPLINE (N,X,Y,A,B,C,D)                                 SPL  10
C     CUBIC SPLINE INTERPOLATION                                        SPL  20
      DIMENSION S(125),H(22),CA(22),X(1),Y(1)                           SPL  30
      DIMENSION A(1),B(1),C(1),D(1)                                     SPL  40
      I=1                                                               SPL  50
      NI=N+1                                                            SPL  60
      N1=N-1                                                            SPL  70
      H(NI)=0.                                                          SPL  80
      H(1)=X(3)-X(2)                                                    SPL  90
      H(2)=-X(3)+X(1)                                                   SPL 100
      H(3)=X(2)-X(1)                                                    SPL 110
      DO 10 K=4,N                                                       SPL 120
10    H(K)=0.                                                           SPL 130
      DO 20 K=1,N                                                       SPL 140
20    S(K)=-H(K+1)/H(1)                                                 SPL 150
      NJ=N-1                                                            SPL 160
      DO 70 I=2,N                                                       SPL 170
      IF (I.EQ.N) GO TO 30                                              SPL 180
      H(NI)=-6.*((Y(I+1)-Y(I))/(X(I+1)-X(I))-(Y(I)-Y(I-1))/(X(I)-X(I-1))SPL 190
     1)                                                                 SPL 200
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      GO TO 40                                                          SPL 210
30    H(NI)=0.                                                          SPL 220
40    DO 60 J=1,N                                                       SPL 230
      H(J)=0.                                                           SPL 240
      IF (I.EQ.N) GO TO 50                                              SPL 250
      IF (J.LT.(I-1).OR.J.GT.(I+1)) GO TO 60                            SPL 260
      H(I-1)=X(I)-X(I-1)                                                SPL 270
      H(I)=2.*(X(I+1)-X(I-1))                                           SPL 280
      H(I+1)=X(I+1)-X(I)                                                SPL 290
      GO TO 60                                                          SPL 300
50    H(N-2)=X(N)-X(N-1)                                                SPL 310
      H(N-1)=-X(N)+X(N-2)                                               SPL 320
      H(N)=X(N-1)-X(N-2)                                                SPL 330
60    CONTINUE                                                          SPL 340
      II=I                                                              SPL 350
      CALL VMSEQN (NJ,II,H,S,CA)                                        SPL 360
      NJ=NJ-1                                                           SPL 370
70    CONTINUE                                                          SPL 380
      DO 80 I=1,N1                                                      SPL 390
      A(I)=(S(I+1)-S(I))/(6.*(X(I+1)-X(I)))                             SPL 400
      B(I)=S(I)/2.                                                      SPL 410
      C(I)=(Y(I+1)-Y(I))/(X(I+1)-X(I))-(X(I+1)-X(I))*(2.*S(I)+S(I+1))/6.SPL 420
      D(I)=Y(I)                                                         SPL 430
80    CONTINUE                                                          SPL 440
      RETURN                                                            SPL 450
      END                                                               SPL 460-


      OVERLAY (LEVSP,2,0)                                               PLT  10
      PROGRAM APLOT                                                     PLT  20
C     SETS UP DIMENSIONS FOR PLOTTING LEADING-EDGE AND WAKE ELEMENTS    PLT  30
      COMMON D(1)                                                       PLT  40
      COMMON /ALLI/ NSW,NSW1,NCW                                        PLT  50
      COMMON /ABC/ PXE(10,40),PYE(10,40),PZE(10,40),PXXE(11,20),        PLT  60
     1PYYE(11,20),PZZE(11,20),NMAX,NNMAX,NCONTS                         PLT  70
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                PLT  80
      NSW=MAXW                                                          PLT  90
      NSW1=MAXL                                                         PLT 100
      MXE=1                                                             PLT 110
      MYE=MXE+NSW1*40                                                   PLT 120
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      MZE=MYE+NSW1*40                                                   PLT 130
      MNELM=MZE+NSW1*40                                                 PLT 140
      MNEXT=MNELM+NSW1                                                  PLT 150
C     MNEXT=3*NSW*NMAX-3*NMAX+NSW                                       PLT 160
      CALL PLOTT (D(MXE),D(MYE),D(MZE),D(MNELM),NSW1,1)                 PLT 170
      MXXE=1                                                            PLT 180
      MYYE=MXXE+NSW*(NNMAX+2)                                           PLT 190
      MZZE=MYYE+NSW*(NNMAX+2)                                           PLT 200
      MNNELM=MZZE+NSW*(NNMAX+2)                                         PLT 210
      MNNEXT=MNNELM+NSW                                                 PLT 220
C     MNNEXT=3*NSW*(NNMAX+2)+NSW+1                                      PLT 230
      CALL PLOTT (D(MXXE),D(MYYE),D(MZZE),D(MNNELM),NSW,2)              PLT 240
      MTXE=1                                                            PLT 250
      MTYE=MTXE+NCW*40                                                  PLT 260
      MTZE=MTYE+NCW*40                                                  PLT 270
      MTELM=MTZE+NCW*40                                                 PLT 280
      MTEXT=MTELM+NCW                                                   PLT 290
C     MTEXT=3*NCW*40+NCW+1                                              PLT 300
      CALL PLOTT (D(MTXE),D(MTYE),D(MTZE),D(MTELM),NCW,3)               PLT 310
      RETURN                                                            PLT 320
      END                                                               PLT 330-


      SUBROUTINE PLOTT (XE,YE,ZE,NNM,NS,LS)                             PTT  10
C     MANIPULATES LEADING-EDGE AND WAKE ELEMENTS COORDINATES IN A FORM  PTT  20
C     SUITABLE FOR PLOTTING                                             PTT  30
      COMMON /ALLI/ NSW,NSW1,NCW                                        PTT  40
      COMMON /TIPVX/ XTIP(15,30),YTIP(15,30),ZTIP(15,30),NTLM(15)       PTT  50
      COMMON /LOC/ FU1,FU2,XEND,PXL(5),PXT(5),PYL(5)                    PTT  60
      COMMON /GENCF/ M1(5),NW(2),YBREAK(5),CH(90),SJ(31,3),MJW1(2),     PTT  70
     1MJW2(2),WIDTH(5),SWEEP(60),NTS,NB                                 PTT  80
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                PTT  90
      COMMON /XPLOT/ XMN,YMN,ZMN,XMX,YMX,ZMX                            PTT 100
      COMMON /ABC/ PXE(10,40),PYE(10,40),PZE(10,40),PXXE(11,20),        PTT 110
     1PYYE(11,20),PZZE(11,20),NMAX,NNMAX,NCONTS                         PTT 120
      COMMON /ALLRB/ AX(210),ZMIN,NELM(11),NNELM(12)                    PTT 130
      DIMENSION NNM(1), XE(NS,1), YE(NS,1), ZE(NS,1), LABY(14), LABZ(14)PTT 140
      DIMENSION LABX(14)                                                PTT 150
      DATA LABX/6*6H      ,6HY VS Z,6*6H      ,2H  /                    PTT 160
      DATA LABY/6*6H      ,6HX VS Y,6*6H      ,2H  /                    PTT 170
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      DATA LABZ/6*6H      ,6HX VS Z,6*6H      ,2H  /                PTT 180
      NSW=MAXW                                                      PTT 190
      NSW1=MAXL                                                     PTT 200
      IF (LS.EQ.2) GO TO 30                                         PTT 210
      IF (LS.EQ.3) GO TO 60                                         PTT 220
      DO 20 I=1,NSW1                                                PTT 230
      KK=NELM(I)                                                    PTT 240
      DO 10 J=1,KK                                                  PTT 250
      XE(I,J)=PXE(I,J)                                              PTT 260
      YE(I,J)=PYE(I,J)                                              PTT 270
      ZE(I,J)=PZE(I,J)                                              PTT 280
10    CONTINUE                                                      PTT 290
20    NNM(I)=KK                                                     PTT 300
      NC=4                                                          PTT 310
      GO TO 90                                                      PTT 320
30    CONTINUE                                                      PTT 330
      DO 50 I=1,NSW                                                 PTT 340
      KK=NNFLM(I)                                                   PTT 350
      DO 40 J=1,KK                                                  PTT 360
      XE(I,J)=PXXE(I,J)                                             PTT 370
      YE(I,J)=PYYE(I,J)                                             PTT 380
      ZE(I,J)=PZZE(I,J)                                             PTT 390
40    CONTINUE                                                      PTT 400
50    NNM(I)=KK                                                     PTT 410
C     ***********************************************************PTT 420
      NC=0                                                          PTT 430
      GO TO 90                                                      PTT 440
60    CONTINUE                                                      PTT 450
      IF (ABS(PXT(NB+1)-PXL(NB+1)).LE.0.00001) RETURN               PTT 460
      DO 80 I=1,NCW                                                 PTT 470
      KK=NTLM(I)                                                    PTT 480
      DO 70 J=1,KK                                                  PTT 490
      XE(I,J)=XTIP(I,J)                                             PTT 500
      YE(I,J)=YTIP(I,J)                                             PTT 510
      ZE(I,J)=ZTIP(I,J)                                             PTT 520
70    CONTINUE                                                      PTT 530
      XE(I,KK+1)=XMN                                                PTT 540
      YE(I,KK+1)=YMN                                                PTT 550
      ZE(I,KK+1)=ZMN                                                PTT 560
      XE(I,KK+2)=XMX                                                PTT 570
      YE(I,KK+2)=YMX                                                PTT 580
```

```
      ZE(I,KK+2)=ZMX                                                    PTT 590
80    NNM(I)=KK+2                                                       PTT 600
      NS1=NS                                                            PTT 610
      GO TO 120                                                         PTT 620
90    DO 110 L=2,NS                                                     PTT 630
      I=L-1                                                             PTT 640
      K=NNM(L)-NC                                                       PTT 650
      DO 100 J=1,K                                                      PTT 660
      KK=J+NC                                                           PTT 670
      XE(I,J)=XE(L,KK)                                                  PTT 680
      YE(I,J)=YE(L,KK)                                                  PTT 690
100   ZE(I,J)=ZE(L,KK)                                                  PTT 700
      XE(I,K+1)=XMN                                                     PTT 710
      YE(I,K+1)=YMN                                                     PTT 720
      ZE(I,K+1)=ZMN                                                     PTT 730
      XE(I,K+2)=XMX                                                     PTT 740
      YE(I,K+2)=YMX                                                     PTT 750
      ZE(I,K+2)=ZMX                                                     PTT 760
110   NNM(I)=K+2                                                        PTT 770
      NS1=NS-1                                                          PTT 780
120   CONTINUE                                                          PTT 790
      CALL LNPLOT (XE,YE,NNM,NS1,NS,LABY)                               PTT 800
      CALL LNPLOT (XE,ZE,NNM,NS1,NS,LABZ)                               PTT 810
      CALL LNPLOT (YE,ZE,NNM,NS1,NS,LABX)                               PTT 820
      RETURN                                                            PTT 830
      END                                                               PTT 840-


      SUBROUTINE LNPLOT (X,Y,NELM,M,MMAX,LABEL)                         LNP  10
C     GENERATES PLOT ON LINE PRINTER (WRITTEN BY KU COMPUTATION CENTER) LNP  20
      DIMENSION NELM(MMAX), X(MMAX,1), Y(MMAX,1), ALINE(101), YAXIS(101)LNP  30
     1, SYM(20), LABEL(1)                                               LNP  40
      COMMON /TAPE/ ITEST,IGOOD,SFAC(10),KU3,NSTOP                      LNP  50
      DATA SYM/1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H0,1HA,1HB,1HC,1HD,1LNP  60
     1HE,1HF,1HG,1HH,1HI,1HJ/                                           LNP  70
      DATA YAXIS/1HI,9*1H-,1HI,9*1H-,1HI,9*1H-,1HI,9*1H-,1HI,9*1H-,1HI,9LNP  80
     1*1H-,1HI,9*1H-,1HI,9*1H-,1HI,9*1H-,1HI,9*1H-,1HI/                 LNP  90
      DATA BLANK,UP,PLUS/1H ,1HI,1H+/                                   LNP 100
      XMAX=X(1,1)                                                       LNP 110
      XMIN=X(1,1)                                                       LNP 120
```

```
      YMAX=Y(1,1)                                                       LNP 130
      YMIN=Y(1,1)                                                       LNP 140
      DO 10 I=1,M                                                       LNP 150
      N=NELM(I)                                                         LNP 160
      DO 10 J=1,N                                                       LNP 170
      IF (X(I,J).GT.XMAX) XMAX=X(I,J)                                   LNP 180
      IF (X(I,J).LT.XMIN) XMIN=X(I,J)                                   LNP 190
      IF (Y(I,J).GT.YMAX) YMAX=Y(I,J)                                   LNP 200
      IF (Y(I,J).LT.YMIN) YMIN=Y(I,J)                                   LNP 210
10    CONTINUE                                                          LNP 220
      KEY=1                                                             LNP 230
      ZMAX=XMAX                                                         LNP 240
      ZMIN=XMIN                                                         LNP 250
20    RANGE=ZMAX-ZMIN                                                   LNP 260
      IF (RANGE.EQ.0.0) RANGE=ZMAX/2.                                   LNP 270
      SCALE=1.0E-9                                                      LNP 280
30    SCALE=10.*SCALE                                                   LNP 290
      IF (SCALE.LT.RANGE) GO TO 30                                      LNP 300
      ZMIN=ZMIN/SCALE                                                   LNP 310
      ZMAX=ZMAX/SCALE                                                   LNP 320
      MIN=20.*(ZMIN-0.025)                                              LNP 330
      MAX=20.0*(ZMAX+0.025)                                             LNP 340
      BOTTOM=0.05*FLOAT(MIN)                                            LNP 350
      TOP=0.05*FLOAT(MAX)                                               LNP 360
      RANGE=0.1*(TOP-BOTTOM)                                            LNP 370
      IF (RANGE.EQ.0.0) RANGE=0.1*(TOP/2.)                              LNP 380
40    IF (BOTTOM.LE.ZMIN) GO TO 50                                      LNP 390
      BOTTOM=BOTTOM-RANGE                                               LNP 400
      GO TO 40                                                          LNP 410
50    IF (TOP.GE.ZMAX) GO TO 60                                         LNP 420
      TOP=TOP+RANGE                                                     LNP 430
      GO TO 50                                                          LNP 440
60    CONTINUE                                                          LNP 450
      IF (KEY.EQ.2) GO TO 70                                            LNP 460
      KEY=2                                                             LNP 470
      ZMAX=YMAX                                                         LNP 480
      ZMIN=YMIN                                                         LNP 490
      YINC=0.01*(TOP-BOTTOM)                                            LNP 500
      XINC=YINC*SCALE                                                   LNP 510
      XBOT=BOTTOM*SCALE                                                 LNP 520
      GO TO 20                                                          LNP 530
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70    CONTINUE                                                          LNP 540
      YINC=0.0125*(TOP-BOTTOM)                                          LNP 550
      YLOW=TOP+YINC                                                     LNP 560
      YINC=2.*YINC                                                      LNP 570
      WRITE (6,150)                                                     LNP 580
      IF (ITER.GE.KU3) WRITE (ITEST,150)                                LNP 590
      KEY=5                                                             LNP 600
80    CONTINUE                                                          LNP 610
      DO 90 IJ=2,101                                                    LNP 620
90    ALINE(IJ)=BLANK                                                   LNP 630
      YHIGH=YLOW                                                        LNP 640
      YLOW=YHIGH-YINC                                                   LNP 650
      YHS=SCALE*YHIGH                                                   LNP 660
      YLS=SCALE*YLOW                                                    LNP 670
      DO 110 I=1,M                                                      LNP 680
      N=NELM(I)                                                         LNP 690
      DO 110 J=1,N                                                      LNP 700
      IF (Y(I,J).GT.YHS.OR.Y(I,J).LE.YLS) GO TO 110                     LNP 710
      INDEX=(X(I,J)-XROT)/XINC                                          LNP 720
      INDEX=INDEX+1                                                     LNP 730
      IF (INDEX.GT.101) INDEX=101                                       LNP 740
      IF (ALINE(INDEX).NE.BLANK) GO TO 100                              LNP 750
      ALINE(INDEX)=SYM(I)                                               LNP 760
      GO TO 110                                                         LNP 770
100   ALINE(INDEX)=PLUS                                                 LNP 780
110   CONTINUE                                                          LNP 790
      ALINE(1)=UP                                                       LNP 800
      IF (KEY.NE.5) GO TO 120                                           LNP 810
      TPP=TOP*SCALF                                                     LNP 820
      WRITE (6,160) TPP,ALINE                                           LNP 830
      IF (ITER.GE.KU3) WRITE (ITEST,160) TPP,ALINE                      LNP 840
      GO TO 130                                                         LNP 850
120   WRITE (6,170) ALINE                                               LNP 860
      IF (ITER.GE.KU3) WRITE (ITEST,170) ALINE                          LNP 870
130   CONTINUE                                                          LNP 880
      KEY=KEY-1                                                         LNP 890
      IF (KEY.EQ.0) KEY=5                                               LNP 900
      TOP=TOP-YINC                                                      LNP 910
      IF (TOP.GE.BOTTOM) GO TO 80                                       LNP 920
      IF (KEY.NE.4) GO TO 80                                            LNP 930
      WRITE (6,200) YAXIS                                               LNP 940
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      IF (ITER.GE.KU3) WRITE (ITEST,200) YAXIS                          LNP 950
      XINC=10.0*XINC                                                    LNP 960
      ALINE(1)=XBOT                                                     LNP 970
      DO 140 I=2,11                                                     LNP 980
140   ALINE(I)=ALINE(I-1)+XINC                                          LNP 990
      WRITE (6,180) (ALINE(I),I=1,11)                                   LNP1000
      IF (ITER.GE.KU3) WRITE (ITEST,180) (ALINE(I),I=1,11)              LNP1010
      WRITE (6,190) (LABEL(I),I=1,14)                                   LNP1020
      IF (ITER.GE.KU3) WRITE (ITEST,190) (LABEL(I),I=1,14)              LNP1030
      RETURN                                                            LNP1040
C                                                                       LNP1050
150   FORMAT (1H1,/)                                                    LNP1070
160   FORMAT (1H ,F10.3,1X,101A1)                                       LNP1080
170   FORMAT (1H ,11X,101A1)                                            LNP1090
180   FORMAT (1H ,5X,11F10.3)                                           LNP1100
190   FORMAT (1H ,//,20X,13A6,A2)                                       LNP1110
200   FORMAT (1H ,11X,101A1)                                            LNP1120
      END                                                               LNP1130-


      OVERLAY (LEVSP,3,0)                                               SLN  10
      PROGRAM SOLN                                                      SLN  20
C     SETS UP DIMENSIONS FOR SOLVING THE STRENGTHS OF WING AND LEADING- SLN  30
C     EDGE VORTEX SYSTEM                                                SLN  40
      COMMON D(1)                                                       SLN  50
      COMMON /ALLI/ NSW,NSW1,NCW,NWNG,NCPTTL                            SLN  60
      LC=1                                                              SLN  70
      LTHETP=LC+NSW1                                                    SLN  80
      LXTE=LTHETP+NSW1                                                  SLN  90
      LXLE=LXTE+NSW                                                     SLN 100
      LYLE=LXLE+NSW                                                     SLN 110
      LCONS=LYLE+NSW                                                    SLN 120
      LCTT=LCONS+NSW1                                                   SLN 130
      LCPWL=LCTT+NSW1                                                   SLN 140
      LCPSW=LCPWL+NCW                                                   SLN 150
      LSI=LCPSW+NSW1                                                    SLN 160
      LSN=LSI+NCW                                                       SLN 170
      LXCP=LSN+NCW                                                      SLN 180
      LYCP=LXCP+NCPTTL                                                  SLN 190
      LXN=LYCP+NCPTTL                                                   SLN 200
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      LYN=LXN+2*NWNG                                                    SLN 210
      LCONI=LYN+2*NWNG                                                  SLN 220
      LCONJ=LCONI+NWNG                                                  SLN 230
      LCONK=LCONJ+NWNG                                                  SLN 240
      LCI=LCONK+NWNG                                                    SLN 250
      LCJ=LCI+NWNG                                                      SLN 260
      LCK=LCJ+NWNG                                                      SLN 270
      LDUMY=LCK+NWNG                                                    SLN 280
      LNEXT=LDUMY+8*NWNG                                                SLN 290
C     LNEXT=20*NWNG+10*NSW+3*NCW-6                                      SLN 300
      MNEXT=LCJ+(NWNG+1)**2/4                                           SLN 310
C     MNEXT=(NWNG+1)**2/4+10*NWNG+10*NSW+3*NCW-6                        SLN 320
      CALL AERODN (NWNG,D(LC),D(LTHETP),D(LXTE),D(LXLE),D(LYLE),D(LCONS)SLN 330
     1,D(LSI),D(LSN),D(LXCP),D(LYCP),D(LXN),D(LYN),D(LCONI),D(LCONJ),D(LSLN 340
     2CONK),D(LCI),D(LCJ),D(LCK),D(LDUMY),D(LCTT),D(LCPWL),D(LCPSW))    SLN 350
      RETURN                                                            SLN 360
      END                                                               SLN 370-


      SUBROUTINE AERODN (NWNG,C,THETP,XTE,XLE,YLE,CONS,SI,SN,XCP,YCP,XN,AER  10
     1YN,CONI,CONJ,CONK,CI,CJ,CK,DUMMY,CT,CPCWL,CPSW1)                  AER  20
C     SOLVES FOR THE STRENGTHS OF WING AND LEADING-EDGE VORTEX SYSTEM   AER  30
      COMMON /TAPE/ ITEST,IGOOD,SFAC(10),KU3,NSTOP                      AER  40
      COMMON /LEFLP/ YLEF(10,2),XNF(10),YNF(10),ZNF(10),XLF(10,4),      AER  50
     1YLF(10,4),SLP1(10),SS,CS,ITERS,ZBDYV(200),ZBDY(200)               AER  60
      COMMON /ALLI/ NSW,NSW1,NCW,IWNG,NCPTTL                            AER  70
      COMMON /ALLRA/ AA(17),SINA,AB(6),BSQD4P                           AER  80
      COMMON /GM/ ITER,L1,L2,L3,L4,L5,L6,L7,L8                          AER  90
      COMMON /NCTT/ NCT,NCON,NBT,NCOR(15),KU1,NFSH(15),KUC,FLG(10)      AER 100
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                AER 110
      COMMON /GENCF/ M1(5),NW(2),YBREAK(5),CH(90),SJ(31,3),MJW1(2),     AER 120
     1MJW2(2),WIDTH(5),SWEEP(60),NTS,NC                                 AER 130
      COMMON/CAMB/ ICAM,IM(10),XT(10,21),AAM(10,20),BBM(10,20),         AER 140
     1CCM(10,20),DDM(10,20),YT(10),ZBDX(200),ZBDXV(200)                 AER 150
      DIMENSION C(1), THETP(1), XTE(1), XLE(1), YLE(1), CONS(1), SI(1), AER 160
     1SN(1), XCP(1), YCP(1), DUMMY(1), CONI(1), CONJ(1), CONK(1), CI(1),AER 170
     2 CJ(1), CK(1), CT(1), CPCWL(1), CPSW1(1), XN(NWNG,2), YN(NWNG,2)  AER 180
C     ***********************************************************AER 190
      REWIND 1                                                          AER 200
      REWIND 2                                                          AER 210
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      REWIND 3                                                          AER 220
      CALL SKIPR (1,7)                                                  AER 230
      READ (1) (C(I),I=1,NSW1)                                          AER 240
      READ (1) (THETP(I),I=1,NSW1)                                      AER 250
      READ (1) (XTE(I),XLE(I),YLE(I),I=1,NSW)                           AER 260
      CALL SKIPR (1,1)                                                  AER 270
      READ (1) (CONS(I),I=1,NSW1)                                       AER 280
      READ (1) (SI(I),SN(I),I=1,NCW)                                    AER 290
      READ (1) (XCP(I),YCP(I),I=1,NCPTTL)                               AER 300
      READ (1) ((XN(I,J),YN(I,J),J=1,2),I=1,NWNG)                       AER 310
      READ (1) (CT(I),I=1,NSW1)                                         AER 320
      READ (1) (CPCWL(I),I=1,NCW)                                       AER 330
      CALL SKIPR (1,2)                                                  AER 340
      READ (1) (CPSW1(I),I=1,NSW1)                                      AER 350
C     ***********************************************************************AER 360
C     INFLUENCE COEFFICIENT MATRIX EVALUATION                           AER 370
      L1=1                                                              AER 380
      L2=L1+NWNG                                                        AER 390
      L3=L2+NWNG                                                        AER 400
      L4=L3+NWNG                                                        AER 410
      L5=L4+NWNG                                                        AER 420
      L6=L5+NWNG                                                        AER 430
      L7=L6+NWNG                                                        AER 440
      L8=L7+NWNG                                                        AER 450
      NCON=0                                                            AER 460
      NCT=0                                                             AER 470
      DO 10 I=1,NCPTTL                                                  AER 480
      ZCP=0.                                                            AER 490
      CALL VDTWNG (C,THETP,XCP(I),YCP(I),ZCP,XN,YN,XTE,YLE,CONS,DUMMY(L1AER 500
     1),DUMMY(L2),DUMMY(L3),DUMMY(L4),DUMMY(L5),DUMMY(L6),DUMMY(L7),DUMMAER 510
     2Y(L8),CONI,CONJ,CONK,SI,NSW1,NCW,NWNG)                            AER 520
      WRITE (2) (CONK(J),J=1,NWNG)                                      AER 530
      CALL VDTFRE (XCP(I),YCP(I),ZCP,CI,CJ,CK,NSW1,BSQD4P,XLE,YLE)      AER 540
      WRITE (3) (CK(J),J=1,MAXL)                                        AER 550
10    CONTINUE                                                          AER 560
C     GAMA-EVALUATION                                                   AER 570
      REWIND 2                                                          AER 580
      REWIND 3                                                          AER 590
      READ (2) (CONI(I),I=1,NWNG)                                       AER 600
      NWNG1=NWNG+1                                                      AER 610
      NWNB=NWNG+MAXL                                                    AER 620
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      NWNB1=NWNB+1                                                      AER 630
      READ (3) (CONI(I),I=NWNG1,NWNB)                                   AER 640
      CONI(NWNB1)=(SINA-ZBDX(1)*AB(1))                                  AER 650
      IJ=1                                                              AER 660
      DO 20 I=1,NWNB                                                    AER 670
20    CJ(I)=-CONI(I+1)/CONI(1)                                          AER 680
      IJ=2                                                              AER 690
      NJ=NWNB-1                                                         AER 700
30    CONTINUE                                                          AER 710
      READ (2) (CONI(I),I=1,NWNG)                                       AER 720
      READ (3) (CONI(I),I=NWNG1,NWNB)                                   AER 730
      CONI(NWNB1)=(SINA-ZBDX(IJ)*AB(1))                                 AER 740
      IF (IJ.GT.NWNG) CONI(NWNB1)=(SINA-CT(IJ-NWNG)-ZBDX(IJ)*AB(1))     AER 750
      CALL VMSEQN (NJ,IJ,CONI,CJ,CONK)                                  AER 760
      IJ=IJ+1                                                           AER 770
      NJ=NJ-1                                                           AER 780
      IF (IJ.LE.NWNB) GO TO 30                                          AER 790
      WRITE (6,80)                                                      AER 800
      IF (ITER.GE.KU3) WRITE (ITEST,80)                                 AER 810
      DO 40 I=1,NSW1                                                    AER 820
      DO 40 J=1,NCW                                                     AER 830
      NP=(I-1)*NCW+J                                                    AER 840
      IF (ITER.GE.KU3) WRITE (ITEST,90) CPCWL(J),CPSW1(I),CJ(NP)        AER 850
40    WRITE (6,90) CPCWL(J),CPSW1(I),CJ(NP)                             AER 860
      WRITE (6,100)                                                     AER 870
      IF (ITER.GE.KU3) WRITE (ITEST,100)                                AER 880
      DO 50 I=1,MAXL                                                    AER 890
      J=NWNG+I                                                          AER 900
      FLG(I)=CJ(J)                                                      AER 910
      IF (ITER.GE.KU3) WRITE (ITEST,90) CPSW1(I),CJ(J)                  AER 920
50    WRITE (6,90) CPSW1(I),CJ(J)                                       AER 930
C     EVALUATION OF SECTIONAL LEADING-EDGE THRUST                       AER 940
      CALL THRST (CJ,CONI,CONJ)                                         AER 950
      NERR=0                                                            AER 960
      DO 60 I=1,MAXL                                                    AER 970
60    IF (ABS(CONJ(I)-CT(I)).GE.(1.0E-10)) NERR=1                       AER 980
      IF (NERR.EQ.1) WRITE (6,110)                                      AER 990
      GMSUM=0.                                                          AER1000
      DO 70 I=2,MAXL                                                    AER1010
      KS=NWNG+I                                                         AER1020
70    GMSUM=GMSUM+CJ(KS)                                                AER1030
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C     ..............................................................AER1040
      REWIND 2                                                      AER1050
      WRITE (2) (CJ(I),I=1,NWNB)                                    AER1060
      WRITE (7) GMSUM                                               AER1070
C     ..............................................................AER1080
      RETURN                                                        AER1090
C                                                                   AER1100
80    FORMAT (1H1,//,22H WING VORTEX STRENGTHS,/,22H ******************AER1120
     1**,//,29H      X/C      2Y/B     GAMAY,/,29H      ***      ****  AER1130
     2  *****)                                                      AER1140
90    FORMAT (1H ,3F10.5)                                           AER1150
100   FORMAT (1H ,//,32H LEADING-EDGE VORTICES STRENGTHS,/,31H *********AER1160
     1**********************,//,20H     2Y/B    CAPGAMA,/,20H     ****  AER1170
     2 *******)                                                     AER1180
110   FORMAT (//,34H ERROR IN SECTIONAL CT CALCULATION,/,10F10.5)   AER1190
      END                                                           AER1200-
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      SUBROUTINE THRST (SGM,CONK,CT)                                THR  10
C     EVALUATES SECTIONAL LEADING-EDGE THRUST COEFFICIENTS          THR  20
      COMMON /ALLI/ NSW,NSW1,NCW,NWNG                               THR  30
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC            THR  40
      COMMON /LEFLP/ YLEF(10,2),XNF(10),YNF(10),ZNF(10),XLF(10,4),  THR  50
     1YLF(10,4),SLP1(10),SS,CS,ITERS,ZBDYV(200),ZBDY(200)           THR  60
      COMMON /ALLRA/ AA(17),SINA,COSA,SWPLE,AB,BETA2,AC(5),PI       THR  70
      COMMON/CAMB/ ICAM,IM(10),XT(10,21),AAM(10,20),BBM(10,20),     THR  80
     1CCM(10,20),DDM(10,20),YT(10),ZBDX(200),ZBDXV(200)             THR  90
      DIMENSION SGM(1), CONK(1), CT(1)                              THR 100
      AM2=1.-BETA2                                                  THR 110
      FCOS=COS(SWPLE)                                               THR 120
      FTAN=TAN(SWPLE)                                               THR 130
      VAR1=FLOAT(NCW)*SQRT(FTAN*FTAN+BETA2)                         THR 140
      VAR2=SQRT(1.-AM2*FCOS*FCOS)                                   THR 150
      REWIND 2                                                      THR 160
      REWIND 3                                                      THR 170
      CALL SKIPR (2,NWNG)                                           THR 180
      CALL SKIPR (3,NWNG)                                           THR 190
      DO 30 I=1,MAXL                                                THR 200
      WL=0.                                                         THR 210
      READ (2) (CONK(J),J=1,NWNG)                                   THR 220
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      DO 10 J=1,NWNG                                                    THR 230
10    WL=WL+CONK(J)*SGM(J)                                              THR 240
      READ (3) (CONK(J),J=1,MAXL)                                       THR 250
      DO 20 J=1,MAXL                                                    THR 260
      JJ=NWNG+J                                                         THR 270
20    WL=WL+CONK(J)*SGM(JJ)                                             THR 280
      THRT1=(WL+(SINA-ZBDX(NWNG+I)*COSA))/VAR1                          THR 290
30    CT(I)=(PI/2.)*VAR2*THRT1*THRT1/FCOS                               THR 300
      RETURN                                                            THR 310
      END                                                               THR 320-


      OVERLAY (LEVSP,4,0)                                               LOD  10
      PROGRAM LOADS                                                     LOD  20
C     SETS UP DIMENSIONS FOR EVALUATING AERODYNAMIC CHARACTERSTICS      LOD  30
      COMMON D(1)                                                       LOD  40
      COMMON /ALLI/ NSW,NSW1,NCW,NWNG                                   LOD  50
      COMMON /GENCF/ M1(5),NW(2),YBREAK(5),CH(90),SJ(31,3),MJW1(2),     LOD  60
     1MJW2(2),WIDTH(5),SWEEP(60),NTS,NC                                 LOD  70
      DIMENSION W(5000)                                                 LOD  80
      NNCW=NCW+1                                                        LOD  90
      NWNP=NNCW*NSW1                                                    LOD 100
      LCI=1                                                             LOD 110
      LCJ=LCI+NWNG                                                      LOD 120
      LCK=LCJ+NWNG                                                      LOD 130
      LCONI=LCK+NWNG                                                    LOD 140
      LCONJ=LCONI+NWNG                                                  LOD 150
      LCONK=LCONJ+NWNG                                                  LOD 160
      LXVWNG=LCONK+NWNG                                                 LOD 170
      LYVWNG=LXVWNG+NWNG                                                LOD 180
      LXLE=LYVWNG+NWNG                                                  LOD 190
      LXTE=LXLE+NSW                                                     LOD 200
      LYLE=LXTE+NSW                                                     LOD 210
      LSI=LYLE+NSW                                                      LOD 220
      LC=LSI+NCW                                                        LOD 230
      LSWP=LC+NSW1                                                      LOD 240
      LXN=LSWP+NCW*NC                                                   LOD 250
      LYN=LXN+2*NWNG                                                    LOD 260
      LSNN=LYN+2*NWNG                                                   LOD 270
      LTHETP=LSNN+NCW                                                   LOD 280
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      LCONS=LTHETP+NSW1                                                 LOD 290
      LDUMMY=LCONS+NSW1                                                 LOD 300
      LCT=LDUMMY+8*NWNG                                                 LOD 310
      LQI=LCT+NSW1                                                      LOD 320
      LQNN=LQI+NNCW                                                     LOD 330
      LQSWP=LQNN+NNCW                                                   LOD 340
      LXVWNA=LQSWP+NNCW*NC                                              LOD 350
      LYVWNA=LXVWNA+NSW1                                                LOD 360
      LGAMA=LYVWNA+NSW1                                                 LOD 370
      LGML=LGAMA+NWNG+NSW1                                              LOD 380
      LXLM=LGML+NSW1                                                    LOD 390
      LTHT=LXLM+NSW1                                                    LOD 400
      LSCL=LTHT+NNCW                                                    LOD 410
      LSCM=LSCL+NSW1                                                    LOD 420
      LSCD=LSCM+NSW1                                                    LOD 430
      LCOSP=LSCD+NSW1                                                   LOD 440
      LCNC=LCOSP+NNCW                                                   LOD 450
      LCSWL=LCNC+NSW1                                                   LOD 460
      LCSW1=LCSWL+NSW                                                   LOD 470
      LDCPA=LCSW1+NSW1                                                  LOD 480
      LDCP=LDCPA+NSW                                                    LOD 490
      LGMNW=LDCP+NWNP                                                   LOD 500
      LGMY=LGMNW+NWNP                                                   LOD 510
      LVY=LGMY+NWNG+NSW1                                                LOD 520
      LCOEF=LVY+NWNG                                                    LOD 530
      LDCPN=LCOEF+NSW1*(NNCW+1)                                         LOD 540
      LWX=LDCPN+NSW1                                                    LOD 550
      LWY=LWX+NWNG+NCW                                                  LOD 560
      LNEXT=LWY+NWNG+NCW                                                LOD 570
C     LNEXT=28*NWNG+25*NSW+10*NCW-14                                    LOD 580
      CALL COEFS (D(LCI),D(LCJ),D(LCK),D(LCONI),D(LCONJ),D(LCONK),D(LXVWLOD 590
     1NG),D(LYVWNG),D(LXLE),D(LXTE),D(LYLE),D(LSI),D(LC),D(LSWP),D(LXN),LOD 600
     2D(LYN),D(LSNN),D(LTHETP),D(LCONS),D(LDUMMY),D(LCT),D(LQI),D(LQNN),LOD 610
     3D(LQSWP),D(LXVWNA),D(LYVWNA),NWNG,D(LGAMA),D(LGML),D(LXLM),D(LTHT)LOD 620
     4,D(LSCL),D(LSCM),D(LSCD),D(LCOSP),D(LCNC),D(LCSWL),D(LCSW1),D(LDCPLOD 630
     5A),D(LDCP),D(LGMNW),D(LGMY),D(LVY),D(LCOEF),D(LDCPN),D(LWX),D(LWY)LOD 640
     6,W,NSW1)                                                          LOD 650
      RETURN                                                            LOD 660
      END                                                               LOD 670-
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      SUBROUTINE COEFS (CI,CJ,CK,CONI,CONJ,CONK,XAVWNG,YAVWNG,XLE,XTE,YLCOF  10
     1E,SI,C,SWP,XN,YN,SNN,THETP,CONS,DUMMY,CT,QI,QNN,QSWP,XAVWNA,YAVWNACOF  20
     2,NWNG,GAMA,GML,XLM,THT,SECCL,SECCM,SECCD,COSP,CNC,CPSWL,CPSW1,DCPACOF  30
     3,DCP,GMNW,GMY,VY,COEF,DCPN,WX,WY,W,NSW1)                          COF  40
C     COMPUTES THE AERODYNAMIC CHARACTERSTICS                            COF  50
      COMMON /COEFF/ CL,FZMINS(10),FHS(2,10),RATIOS(2,10),               COF  60
     1CFCORE(2,10),RATIOC(2,10)                                          COF  70
      COMMON /ALLRB/ AX(210),ZMIN,NELM(11)                               COF  80
      COMMON /GM/ ITER                                                   COF  90
      COMMON /LEFLP/ YLEF(10,2),XNF(10),YNF(10),ZNF(10),XLF(10,4),       COF 100
     1YLF(10,4),SLP1(10),SS,CS,ITERS,ZBDYV(200),ZBDY(200)                COF 110
     2,CURV(10),CHND(10),SZBDYV(200)                                     COF 120
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                 COF 130
      COMMON /ALLI/ NSW,NSWB,NCW,LWNG,NCPTTL,MITER                       COF 140
      COMMON /LOC/ FU1,FU2,XEND,PXL(5),PXT(5),PYL(5)                     COF 150
      COMMON /GENCF/ M1(5),NW(2),YBREAK(5),CH(90),SJ(31,3),MJW1(2),      COF 160
     1MJW2(2),WIDTH(5),SWEEP(60),NTS,NC                                  COF 170
      COMMON /ALLRA/ AA(17),SINA,COSA,AB(8),PI,AC,CBAR,HALFB,AREA        COF 180
      COMMON /NCTT/ NCT,NCON,NBT,NCOR(15),KU1,NFSH(15),KUC,FLG(10)       COF 190
      COMMON /XSTN/ XBRR(25),NBRR                                        COF 200
      COMMON/CAMB/ ICAM,IM(10),XT(10,21),AAM(10,20),BBM(10,20),          COF 210
     1CCM(10,20),DDM(10,20),YT(10),ZBDX(200),ZBDXV(200)                  COF 220
      DIMENSION CI(1), CJ(1), CK(1), CONI(1), CONJ(1), CONK(1), XAVWNG(1COF 230
     1), YAVWNG(1), XLE(1), XTE(1), YLE(1), SI(1), C(1), SWP(1), SNN(1),COF 240
     2 CT(1), XN(NWNG,2), YN(NWNG,2), DUMMY(1), GAMA(1), GML(1), XLM(1),COF 250
     3 THT(1), SECCL(1), SECCM(1), SECCD(1), COSP(1), CNC(1), CPSWL(1), COF 260
     4CPSW1(1), DCPA(1), DCP(1), GMNW(1), GMY(1), VY(1), DCPN(1), WX(1),COF 270
     5 WY(1), W(1), COEF(NSW1,1), CONS(1), THETP(1), QI(1), QNN(1), QSWPCOF 280
     6(1), XAVWNA(1), YAVWNA(1)                                          COF 290
      DIMENSION CONST(3),XCP(100),YCP(100),CPCW1(10),YLM(15)             COF 300
      DIMENSION AW(4000),AWX(100),AWY(100)                               COF 310
      COMMON /TAPE/ ITEST,IGOOD,SFAC(10),KU3,NSTOP                       COF 320
      DIMENSION F(3),FTX(10,10),FTY(10,10),FTZ(10,10),A(3),B(3),GA(3)    COF 330
      DIMENSION GT(20)                                                   COF 340
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40)                         COF 350
C     ***********************************************************COF 360
      NSW1=NTS                                                           COF 370
      NSW=NTS+1                                                          COF 380
      REWIND 1                                                           COF 390
      READ (1) NNCW,NWNP                                                 COF 400
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      READ (1) (QI(I),QNN(I),I=1,NNCW)                                  COF 410
      N2=NNCW*NC                                                        COF 420
      READ (1) (QSWP(I),I=1,N2)                                         COF 430
      READ (1) (XAVWNA(I),YAVWNA(I),I=1,NSW1)                           COF 440
      READ (1) (SNN(I),I=1,NCW)                                         COF 450
      N3=NCW*NC                                                         COF 460
      READ (1) (SWP(I),I=1,N3)                                          COF 470
      READ (1) (XAVWNG(I),YAVWNG(I),I=1,NWNG)                           COF 480
      READ (1) (C(I),I=1,NSW1)                                          COF 490
      READ (1) (THETP(I),I=1,NSW1)                                      COF 500
      READ (1) (XTE(I),XLE(I),YLE(I),I=1,NSW)                           COF 510
      READ (1) (XLM(I),YLM(I),I=1,NSW1)                                 COF 520
      READ (1) (CONS(I),I=1,NSW1)                                       COF 530
      READ (1) (SI(I),ADUM,I=1,NCW)                                     COF 540
      READ (1) (XCP(I),YCP(I),I=1,NCPTTL)                               COF 550
      READ (1) ((XN(I,J),YN(I,J),J=1,2),I=1,NWNG)                       COF 560
      READ (1) (CT(I),I=1,NSW1)                                         COF 570
      CALL SKIPR (1,1)                                                  COF 580
      READ (1) (CPCW1(I),I=1,NCW)                                       COF 590
      READ (1) (CPSWL(I),I=1,NSW)                                       COF 600
      READ (1) (CPSW1(I),I=1,NSW1)                                      COF 610
      NWNB=NWNG+NSW1                                                    COF 620
      REWIND 2                                                          COF 630
      READ (2) (GAMA(I),I=1,NWNB)                                       COF 640
C     ***********************************************************************COF 650
      PIJ=PI/(2.*FLOAT(NCW))                                            COF 660
      DO 10 J=1,NCW                                                     COF 670
10    COSP(J)=COS((2.*FLOAT(J)-1.)*PIJ)                                 COF 680
      IJ=M1(1)                                                          COF 690
      Y1=YLE(IJ)                                                        COF 700
      MSW=M1(1)                                                         COF 710
      CONST(1)=Y1*PI/(AREA*FLOAT(MSW))                                  COF 720
      IF (ITRAKE.EQ.1) GO TO 20                                         COF 730
      Y2=HALFB-Y1                                                       COF 740
      MSW=M1(2)                                                         COF 750
      CONST(2)=Y2*PI/(AREA*FLOAT(MSW))                                  COF 760
20    CONTINUE                                                          COF 770
      DO 40 I=1,NSW1                                                    COF 780
      GT(I)=0.                                                          COF 790
      K1=1                                                              COF 800
      IF (ITRAKE.NE.1.AND.I.GE.M1(1)) K1=M1(1)                          COF 810
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30    GT(I)=GT(I)+GAMA(NWNG+K1)                                        COF 820
      K1=K1+1                                                          COF 830
      IF (K1.GT.I) GO TO 40                                            COF 840
      GO TO 30                                                         COF 850
40    CONTINUE                                                         COF 860
C     CALCULATION OF GMY-VALUES FOR WING SURFACE                       COF 870
      NCON=0                                                           COF 880
      NCT=0                                                            COF 890
      NBT=0                                                            COF 900
      KI=1                                                             COF 910
      MX=M1(KI)-1                                                      COF 920
      DO 70 II=1,NSW1                                                  COF 930
      IF (II.GT.MX) GO TO 50                                           COF 940
      GO TO 60                                                         COF 950
50    KI=KI+1                                                          COF 960
      MX=MX+M1(KI)-1                                                   COF 970
60    CONTINUE                                                         COF 980
      DO 70 J=1,NCW                                                    COF 990
      I=(II-1)*NCW+J                                                   COF1000
      JJ=(KI-1)*NCW+J                                                  COF1010
      XEE=XAVWNG(I)                                                    COF1020
      YEE=YAVWNG(I)                                                    COF1030
      ZEE=0.                                                           COF1040
      CALL NEWVEL (C,THETP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,CONI,CONCOF1050
     1J,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,ADUM,BDUM,CDUM,GAMA,COF1060
     2YLM)                                                             COF1070
      UU=UU                                                            COF1080
      VV=VV                                                            COF1090
      ST=SQRT(1.+SZBDYV(I)**2)                                         COF1100
      SD=SZBDYV(I)/ST                                                  COF1110
      TNSP=TAN(SWP(JJ))                                                COF1120
      PHIY=ATAN(SZBDYV(I))                                             COF1130
      ACP=SS*SIN(PHIY)                                                 COF1140
      GMY(I)=GAMA(I)*(UU-(VV*COS(PHIY)+ACP)*TNSP)                      COF1150
70    CONTINUE                                                         COF1160
C     CALCULATION OF INDUCED VELOCITIES AT BOUND ELEMENT END-POINTS ON COF1180
C     WING SURFACE                                                     COF1190
      NAERO=0                                                          COF1200
      DO 90 I=1,NSW1                                                   COF1210
      DO 80 J=1,NCW                                                    COF1220
      NP=(I-1)*NCW+J                                                   COF1230
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      XEE=XN(NP,2)                                                      COF1240
      YEE=YN(NP,2)                                                      COF1250
      CALL NEWVEL (C,THETP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,CONI,CONCOF1260
     1J,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,ADUM,BDUM,CDUM,GAMA,COF1270
     2YLM)                                                              COF1280
      ST=SQRT(1.+SZBDYV(NP)**2)                                         COF1290
      SD=SZBDYV(NP)                                                     COF1300
      VY(NP)=VV                                                         COF1310
80    CONTINUE                                                          COF1320
90    CONTINUE                                                          COF1330
C     CALCULATION OF GMY-VALUES FOR BOUND ELEMENTS NEAR LEADING-EDGE    COF1340
      DO 100 J=1,NNCW                                                   COF1350
      FJ=J                                                              COF1360
100   THT(J)=(2.*FJ-1.)*PI/(2.*FLOAT(NNCW))                             COF1370
      SURA=8.*FLOAT(NNCW)/(4.*PI*SIN(THT(1)))                           COF1380
      DO 110 I=1,MAXL                                                   COF1390
      NGI=NWNG+I                                                        COF1400
110   GML(I)=GAMA(NGI)*SURA/C(I)                                        COF1410
C     ..................................................................COF1420
      REWIND 3                                                          COF1430
      WRITE (3) (GML(I),I=1,NSW1)                                       COF1440
C     ..................................................................COF1450
      NAERO=1                                                           COF1460
      DO 140 II=1,MAXL                                                  COF1470
      XEE=XAVWNA(II)                                                    COF1480
      YEE=YAVWNA(II)                                                    COF1490
      CALL NEWVEL (C,THETP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,CONI,CONCOF1500
     1J,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,ADUM,BDUM,CDUM,GAMA,COF1510
     2YLM)                                                              COF1520
      JJ=1                                                              COF1530
      KI=1                                                              COF1540
      MX=M1(KI)-1                                                       COF1550
      TNSP=TAN(QSWP(JJ))                                                COF1560
      IF (II.GT.MX) GO TO 120                                           COF1570
      GO TO 130                                                         COF1580
120   KI=KI+1                                                           COF1590
      MX=MX+M1(KI)-1                                                    COF1600
      JJ=(KI-1)*NNCW+1                                                  COF1610
      TNSP=TAN(QSWP(JJ))                                                COF1620
130   CONTINUE                                                          COF1630
      NWNGII=NWNG+II                                                    COF1640
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      IJ=(II-1)*NNCW+1                                                  COF1650
      ST=SQRT(1.+ZBDYV(IJ)**2)                                          COF1660
      SD=ZBDYV(IJ)/ST                                                   COF1670
      PHIY=ATAN(ZBDYV(IJ))                                              COF1680
      ACP=SS*SIN(PHIY)                                                  COF1690
      GMY(NWNGII)=GML(II)*(UU-(VV*COS(PHIY)+ACP)*TNSP)                  COF1700
140   CONTINUE                                                          COF1710
C     CALCULATION OF DCP-VALUES FOR WING POINTS                         COF1720
      PN=PI/(FLOAT(NCW))                                                COF1730
      DO 150 I=1,NCW                                                    COF1740
      W(I)=0.                                                           COF1750
      WX(I)=XN(I,1)                                                     COF1760
150   WY(I)=YN(I,1)                                                     COF1770
      DO 230 I=1,NSW1                                                   COF1780
      DO 220 J=1,NCW                                                    COF1790
      NP=(I-1)*NCW+J                                                    COF1800
      VYY=VY(NP)                                                        COF1810
      CPG=0.                                                            COF1820
      CPH=0.                                                            COF1830
      CPI=0.                                                            COF1840
      IF (I.EQ.NSW1.AND.(PXT(NC+1)-PXL(NC+1)).NE.0.) GO TO 210          COF1850
      DO 170 JJ=1,J                                                     COF1860
      NPIN=(I-1)*NCW+JJ                                                 COF1870
      IF (J.EQ.JJ) GO TO 160                                            COF1880
      CPG=CPG+GAMA(NPIN)*SI(JJ)                                         COF1890
      GO TO 170                                                         COF1900
160   CPG=CPG+0.5*GAMA(NPIN)*SI(JJ)                                     COF1910
170   CONTINUE                                                          COF1920
      IF (I.EQ.NSW1) ACPG=CPG*C(I)*PN                                   COF1930
      CPG=-CPG*PN*C(I)*VYY                                              COF1940
      IF (I.EQ.NSW1) GO TO 200                                          COF1950
      DO 190 JJ=1,J                                                     COF1960
      NPOT=I*NCW+JJ                                                     COF1970
      IF (J.EQ.JJ) GO TO 180                                            COF1980
      CPH=CPH+GAMA(NPOT)*SI(JJ)                                         COF1990
      GO TO 190                                                         COF2000
180   CPH=CPH+0.5*GAMA(NPOT)*SI(JJ)                                     COF2010
190   CONTINUE                                                          COF2020
      CPH=CPH*PN*C(I+1)*VYY                                             COF2030
      GO TO 210                                                         COF2040
200   Y1=YLE(NSW)                                                       COF2050
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      A1=SQRT(1.-(Y1/HALFB)**2)                                         COF2060
      A2=SQRT(1.-(YLM(I)/HALFB)**2)                                     COF2070
      CPH=ACPG*A1/A2*VYY                                                COF2080
210   CPI=2.*GAMA(NWNG+I)*VYY                                           COF2090
      IF (I.NE.NSW1) W(NP+NCW)=2.*(CPG+CPH+CPI)/(YLE(I+2)-YLE(I))       COF2100
      IF (I.EQ.NSW1) W(NP+NCW)=(CPG+CPH+CPI)/(YLE(I+1)-YLE(I))          COF2110
      WX(NP+NCW)=XN(NP,2)                                               COF2120
      WY(NP+NCW)=YN(NP,2)                                               COF2130
220   CONTINUE                                                          COF2140
230   CONTINUE                                                          COF2150
C     STRAKE SECTION INTERPOLATION                                      COF2160
      LL=1                                                              COF2170
      INIP=0                                                            COF2180
      MSX=M1(1)-1                                                       COF2190
      MPX=M1(1)                                                         COF2200
      N3=NCW*M1(1)+3                                                    COF2210
      DO 240 I=1,MPX                                                    COF2220
      DO 240 J=1,NCW                                                    COF2230
      NP=(I-1)*NCW+J                                                    COF2240
      AW(NP)=W(NP)                                                      COF2250
      AWX(NP)=WX(NP)                                                    COF2260
      AWY(NP)=WY(NP)                                                    COF2270
240   CONTINUE                                                          COF2280
      GO TO 270                                                         COF2290
C     WING SECTION INTERPOLATION                                        COF2300
250   LL=2                                                              COF2310
      INIP=NCW*(M1(1)-1)                                                COF2320
      MSX=M1(2)-1                                                       COF2330
      MPX=M1(2)                                                         COF2340
      N3=NCW*M1(2)+3                                                    COF2350
      DO 260 I=1,MPX                                                    COF2360
      DO 260 J=1,NCW                                                    COF2370
      NP=(I-1)*NCW+J                                                    COF2380
      MP=NP+INIP                                                        COF2390
      AW(NP)=W(MP)                                                      COF2400
      AWX(NP)=WX(MP)                                                    COF2410
      AWY(NP)=WY(MP)                                                    COF2420
260   CONTINUE                                                          COF2430
270   CALL SURFSET (N3,AWX,AWY,AW,CI)                                   COF2440
      DO 290 K=1,NCW                                                    COF2450
      DO 280 J=1,MSX                                                    COF2460
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      NP=INIP+(J-1)*NCW+K                                               COF2470
      DCP1=2.*GMY(NP)                                                   COF2480
      XEE=XAVWNG(NP)                                                    COF2490
      YEE=YAVWNG(NP)                                                    COF2500
      CALL SURFORD (AW,XEE,YEE,VV,N3)                                   COF2510
      DCPD=VV                                                           COF2520
      DCP(NP)=DCP1+DCPD                                                 COF2530
280   CONTINUE                                                          COF2540
290   CONTINUE                                                          COF2550
      IF (ITRAKE.NE.1.AND.LL.EQ.1) GO TO 250                            COF2560
C     CALCULATION OF INDUCED VELOCITIES AT END-POINTS OF BOUND ELEMENTS COF2570
C     NEAR LEADING-EDGE                                                 COF2580
      NAERO=0                                                           COF2590
      CPC=0.5*(1.-COS(THT(1)))                                          COF2600
      DO 300 I=2,NSW                                                    COF2610
      XEE=XLE(I)+CPC*(XTE(I)-XLE(I))                                    COF2620
      YEE=YLE(I)                                                        COF2630
      CALL NEWVEL (C,THETP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,CONI,CONCOF2640
     1J,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,ADUM,BDUM,CDUM,GAMA,COF2650
     2YLM)                                                              COF2660
      IJ=(I-2)*NNCW+1                                                   COF2670
      ST=SQRT(1.+ZBDYV(IJ)**2)                                          COF2680
      SD=ZBDYV(IJ)/ST                                                   COF2690
300   VY(I)=VV                                                          COF2700
C     DCP-INTERPOLATION FOR BOUND ELEMENTS OF WING                      COF2710
      CALL INTGMY (NCW,NSW1,DCP,SNN,COEF,DUMMY(1),DUMMY(NNCW))          COF2720
C     CALCULATION OF DECREASE IN DCP-VALUES AT THE LEADING-EDGE         COF2730
      DO 310 I=1,NSW1                                                   COF2740
      CNC(I)=-2.*GMY(NWNG+I)                                            COF2750
310   CONTINUE                                                          COF2760
C     FINAL DCP-VALUES AT LARGER WING GRID                              COF2770
      DO 350 I=1,NSW1                                                   COF2780
      DO 340 J=1,NNCW                                                   COF2790
      NP=(I-1)*NNCW+J                                                   COF2800
      GMNW(NP)=COEF(I,1)                                                COF2810
      DO 320 K=1,NCW                                                    COF2820
      FK=K                                                              COF2830
      AMI1=COS(FK*THT(J))                                               COF2840
      AMI2=AMI1*COEF(I,K+1)                                             COF2850
      GMNW(NP)=GMNW(NP)+AMI2                                            COF2860
320   CONTINUE                                                          COF2870
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      GMNW(NP)=GMNW(NP)/(SIN(THT(J)))                                   COF2880
      IF (J.NE.1) GO TO 330                                             COF2890
      NGI=NWNG+I                                                        COF2900
      GMNW(NP)=GMNW(NP)+CNC(I)                                          COF2910
330   CONTINUE                                                          COF2920
340   CONTINUE                                                          COF2930
350   CONTINUE                                                          COF2940
      DO 360 I=1,NWNP                                                   COF2950
360   DCP(I)=GMNW(I)                                                    COF2960
      DO 370 I=1,NWNP                                                   COF2970
370   CONTINUE                                                          COF2980
      PIJ=PI/(2.*FLOAT(NNCW))                                           COF2990
      WRITE (6,650)                                                     COF3000
      IF (ITER.GE.KU3) WRITE (ITEST,650)                                COF3010
      DO 380 I=1,NSW1                                                   COF3020
      DO 380 J=1,NNCW                                                   COF3030
      NP=(I-1)*NNCW+J                                                   COF3040
      CPCW=0.5*(1.-COS((2.*FLOAT(J)-1.)*PIJ))                           COF3050
      IF (ITER.GE.KU3) WRITE (ITEST,660) CPCW,CPSW1(I),DCP(NP)          COF3060
380   WRITE (6,660) CPCW,CPSW1(I),DCP(NP)                               COF3070
      DO 390 J=1,NNCW                                                   COF3080
390   COSP(J)=COS((2.*FLOAT(J)-1.)*PIJ)                                 COF3090
C     EVALUATION OF SECTIONAL AND TOTAL AERODYNAMIC CHARACTERSTICS      COF3100
      CL=0.                                                             COF3110
      CM=0.                                                             COF3120
      CD=0.                                                             COF3130
      CTT=0.                                                            COF3140
      DO 430 I=1,NSW1                                                   COF3150
      SECCL(I)=0.                                                       COF3160
      SECCD(I)=0.                                                       COF3170
      SECCM(I)=0.                                                       COF3180
      KS=1                                                              COF3190
      MSW=M1(1)                                                         COF3200
      NIM=0                                                             COF3210
      IF (ITRAKE.NE.1.AND.I.GT.M1(1)-1) GO TO 400                       COF3220
      GO TO 410                                                         COF3230
400   KS=2                                                              COF3240
      MSW=M1(2)                                                         COF3250
      NIM=M1(1)-1                                                       COF3260
410   CONTINUE                                                          COF3270
      PHII=PI*FLOAT(I-NIM)/FLOAT(MSW)                                   COF3280
```

```
      SPI=SIN(PHII)                                                     COF3290
      DO 420 J=1,NNCW                                                   COF3300
      NP=(I-1)*NNCW+J                                                   COF3310
      FT=SQRT(1.+ZBDXV(NP)**2+ZBDYV(NP)**2)                             COF3320
      FAC=(ZBDXV(NP)*SS+CS)/FT                                          COF3330
      FAS=(-ZBDXV(NP)*CS+SS)/FT                                         COF3340
      SECCL(I)=SECCL(I)+DCP(NP)*QI(J)*FAC                               COF3350
      SECCD(I)=SECCD(I)+DCP(NP)*QI(J)*FAS                               COF3360
      SECCM(I)=SECCM(I)-DCP(NP)*QI(J)*(XLM(I)+0.5*C(I)*(1.-COSP(J)))/CBACOF3370
     1R/FT                                                              COF3380
420   CONTINUE                                                          COF3390
      SECCL(I)=SECCL(I)*PI/(2.*FLOAT(NNCW))                             COF3400
      SECCM(I)=SECCM(I)*PI/(2.*FLOAT(NNCW))                             COF3410
      SECCD(I)=SECCD(I)*PI/(2.*FLOAT(NNCW))                             COF3420
      NL=NWNG+I                                                         COF3430
      FAS=(-ZBDXV(NL)*CS+SS)/FT                                         COF3440
      FAC=(ZBDXV(NL)*SS+CS)/FT                                          COF3450
      FT=SQRT(1.+ZBDXV(NL)**2+ZBDYV(NL)**2)                             COF3460
      SECCL(I)=SECCL(I)+CT(I)*FAC                                       COF3470
      SECCD(I)=SECCD(I)-CT(I)*FAS                                       COF3480
      CL=CL+SECCL(I)*C(I)*SPI*CONST(KS)                                 COF3490
      CM=CM+SECCM(I)*C(I)*SPI*CONST(KS)                                 COF3500
      CD=CD+SECCD(I)*C(I)*SPI*CONST(KS)                                 COF3510
430   CTT=CTT+CT(I)*C(I)*SPI*CONST(KS)                                  COF3520
C     ..................................................................COF3530
      WRITE (7) CL,CM,CD,CTT                                            COF3540
C     ..................................................................COF3550
      WRITE (6,620) (I,SECCL(I),SECCM(I),SECCD(I),CT(I),I=1,NSW1)       COF3560
      IF (ITER.GE.KU3) WRITE (ITEST,620) (I,SECCL(I),SECCM(I),SECCD(I),CCOF3570
     1T(I),I=1,NSW1)                                                    COF3580
      WRITE (6,630) CL,CM,CD,CTT                                        COF3590
      IF (ITER.GE.KU3) WRITE (ITEST,630) CL,CM,CD,CTT                   COF3600
      NNCW1=NNCW+1                                                      COF3610
      CALL INTGMY (NNCW,NSW1,DCP,QNN,COEF,DUMMY(1),DUMMY(NNCW1))        COF3620
      REWIND 1                                                          COF3630
      CALL SKIPR (1,10)                                                 COF3640
      READ (1) (XLM(I),CI(I),I=1,NSW1)                                  COF3650
C     EVALUATION OF DCP AT CONSTANT X LOCATIONS                         COF3660
      DO 520 K=1,NBRR                                                   COF3670
      XBR=XBRR(K)                                                       COF3680
      IF (XBR.GE.PXL(NC+1)) GO TO 460                                   COF3690
```

```
      KY=1                                                              COF3700
440   IF (XBR.LT.XLM(KY)) GO TO 450                                     COF3710
      KY=KY+1                                                           COF3720
      IF (KY.LE.NSW1) GO TO 440                                         COF3730
450   KY=KY-1                                                           COF3740
      BLOCAL=CI(KY)+(CI(KY+1)-CI(KY))*(XBR-XLM(KY))/(XLM(KY+1)-XLM(KY)) COF3750
      GO TO 470                                                         COF3760
460   BLOCAL=PYL(NC+1)                                                  COF3770
      KY=NSW1                                                           COF3780
470   CONTINUE                                                          COF3790
      DO 490 I=1,KY                                                     COF3800
      CJ(I)=CI(I)/BLOCAL                                                COF3810
      XC=(XBR-XLM(I))/C(I)                                              COF3820
      THTA=ARCOS(1.-2.*XC)                                              COF3830
      DCPN(I)=COEF(I,1)                                                 COF3840
      DO 480 J=1,NNCW                                                   COF3850
480   DCPN(I)=DCPN(I)+COEF(I,J+1)*COS(FLOAT(J)*THTA)                    COF3860
      DCPN(I)=DCPN(I)/(SIN(THTA))                                       COF3870
C     WHENEVER THE NEGATIVE CP OCCURS AFTER SPANWISE INTERPOLATION, THE COF3880
C     FOLLOWING CORRECTION WILL BE MADE                                 COF3890
      IF (DCPN(I).GT.0.) GO TO 490                                      COF3900
      IF (I.EQ.1) GO TO 490                                             COF3910
      DX=CJ(I-1)-1.0                                                    COF3920
      DY=DCPN(I-1)-0.                                                   COF3930
      DYDX=DY/DX                                                        COF3940
      DX1=CJ(I)-1.0                                                     COF3950
      DCPN(I)=DYDX*DX1                                                  COF3960
490   CONTINUE                                                          COF3970
      IF (DCPN(1).LT.0.) GO TO 500                                      COF3980
      GO TO 510                                                         COF3990
500   DX=CJ(2)                                                          COF4000
      DY=DCPN(2)-0.5*DCPN(2)                                            COF4010
      DYDX=DY/DX                                                        COF4020
      DX1=CJ(1)                                                         COF4030
      DCPN(1)=0.5*DCPN(2)+DYDX*DX1                                      COF4040
510   CONTINUE                                                          COF4050
      WRITE (6,640) XBR,(CI(I),CJ(I),DCPN(I),I=1,KY)                    COF4060
      IF (ITER.GE.KU3) WRITE (ITEST,640) XBR,(CI(I),CJ(I),DCPN(I),I=1,KYCOF4070
     1)                                                                 COF4080
520   CONTINUE                                                          COF4090
C     COMPUTE THE FORCE ON THE FREE SHEET SEGMENTS AFTER SATISFING      COF4100
```

```
C     BOUNDARY CONDITION                                                COF4110
      IF (ITER.LT.KU1+1) GO TO 610                                      COF4120
      SFAC(ITER)=0.                                                     COF4130
      NCT=0                                                             COF4140
      LL=1                                                              COF4150
      L1=1                                                              COF4160
      KS=2                                                              COF4170
      KE=M1(1)-1                                                        COF4180
      GO TO 540                                                         COF4190
530   LL=2                                                              COF4200
      L1=M1(1)                                                          COF4210
      KS=M1(1)+1                                                        COF4220
      KE=MAXL                                                           COF4230
540   CONTINUE                                                          COF4240
      NAERO=0                                                           COF4250
      NCR2=NCOR(L1)-2                                                   COF4260
      DO 550 J=5,NCR2                                                   COF4270
      DO 550 I=KS,KE                                                    COF4280
      GMA=GAMA(NWNG+I)                                                  COF4290
      NBT=0                                                             COF4300
      NCON=I                                                            COF4310
      XEE=0.5*(XE(I,J)+XE(I,J+1))                                       COF4320
      YEE=0.5*(YE(I,J)+YE(I,J+1))                                       COF4330
      ZEE=0.5*(ZE(I,J)+ZE(I,J+1))                                       COF4340
      IF (J.EQ.5) FZMINS(I)=0.50*ZE(I,J+1)                              COF4350
      CALL NEWVEL (C,THFTP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,CONI,CONCOF4360
     1J,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,CPCW1,XCP,YCP,GAMA,YCOF4370
     2LM)                                                               COF4380
      A(1)=XE(I,J+1)-XE(I,J)                                            COF4390
      A(2)=YE(I,J+1)-YE(I,J)                                            COF4400
      A(3)=ZE(I,J+1)-ZE(I,J)                                            COF4410
      GA(1)=GMA*A(1)/AREA                                               COF4420
      GA(2)=GMA*A(2)/AREA                                               COF4430
      GA(3)=GMA*A(3)/AREA                                               COF4440
      B(1)=UU                                                           COF4450
      B(2)=VV                                                           COF4460
      B(3)=WW                                                           COF4470
      CALL CRSPRD (B,GA,F)                                              COF4480
      FTX(I,J)=F(1)                                                     COF4490
      FTY(I,J)=F(2)                                                     COF4500
      FTZ(I,J)=F(3)                                                     COF4510
```

```
550   CONTINUE                                                          COF4520
      NSW5=NELM(L1)-NCOR(L1)                                            COF4530
      NAERO=1                                                           COF4540
      CFTX=0.                                                           COF4550
      CFTY=0.                                                           COF4560
      CFTZ=0.                                                           COF4570
      FCXYZ=0.                                                          COF4580
      DO 560 I=1,NSW5                                                   COF4590
      II=NCOR(L1)+I                                                     COF4600
      NCON=(L1-1)+I                                                     COF4610
      IF (NCON.GE.KE) NCON=KE                                           COF4620
      NBT=1                                                             COF4630
      XEE=0.5*(XE(L1,II-1)+XE(L1,II))                                   COF4640
      YEE=0.5*(YE(L1,II-1)+YE(L1,II))                                   COF4650
      ZEE=0.5*(ZE(L1,II-1)+ZE(L1,II))                                   COF4660
      GMA=GT(NCON)                                                      COF4670
      A(1)=XE(L1,II)-XE(L1,II-1)                                        COF4680
      A(2)=YE(L1,II)-YE(L1,II-1)                                        COF4690
      A(3)=ZE(L1,II)-ZE(L1,II-1)                                        COF4700
      CALL NEWVEL (C,THETP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,CONI,CONCOF4710
     1J,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,CPCW1,XCP,YCP,GAMA,YCOF4720
     2LM)                                                               COF4730
      GA(1)=GMA*A(1)/AREA                                               COF4740
      GA(2)=GMA*A(2)/AREA                                               COF4750
      GA(3)=GMA*A(3)/AREA                                               COF4760
      B(1)=UU                                                           COF4770
      B(2)=VV                                                           COF4780
      B(3)=WW                                                           COF4790
      CALL CRSPRD (B,GA,F)                                              COF4800
      FCXYZ=FCXYZ+SQRT(F(1)**2+F(2)**2+F(3)**2)                         COF4810
      CFTX=CFTX+F(1)                                                    COF4820
      CFTY=CFTY+F(2)                                                    COF4830
      CFTZ=CFTZ+F(3)                                                    COF4840
560   CONTINUE                                                          COF4850
      CFTXYZ=SQRT(CFTX**2+CFTY**2+CFTZ**2)                              COF4860
      CFCORE(LL,ITER)=CFTXYZ                                            COF4870
      TFTX=0.                                                           COF4880
      TFTY=0.                                                           COF4890
      TFTZ=0.                                                           COF4900
      FSXYZ=0.                                                          COF4910
      DO 580 I=KS,KE                                                    COF4920
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```
      NCC=NCOR(I)-2                                                     COF4930
      DO 570 J=5,NCC                                                    COF4940
      TFTX=TFTX+FTX(I,J)                                                COF4950
      TFTY=TFTY+FTY(I,J)                                                COF4960
      TFTZ=TFTZ+FTZ(I,J)                                                COF4970
      FSXYZ=FSXYZ+SQRT(FTX(I,J)**2+FTY(I,J)**2+FTZ(I,J)**2)             COF4980
570   CONTINUE                                                          COF4990
580   CONTINUE                                                          COF5000
      TFXYZ=SQRT(TFTX**2+TFTY**2+TFTZ**2)                               COF5010
      FHS(LL,ITER)=TFXYZ                                                COF5020
      SFAC(ITER)=SFAC(ITER)+(FCXYZ+FSXYZ)                               COF5030
      IF (ITRAKE.NE.1.AND.LL.EQ.1) GO TO 530                            COF5040
      IF (ITER.EQ.KU3) GO TO 600                                        COF5050
      IF (ITER.GE.KU3+1) GO TO 590                                      COF5060
      GO TO 610                                                         COF5070
590   CONTINUE                                                          COF5080
      IF (SFAC(ITER).LE.SFAC(ITER-1)) GO TO 600                         COF5090
      REWIND ITEST                                                      COF5100
      NSTOP=1                                                           COF5110
      MITER=ITER                                                        COF5120
      GO TO 610                                                         COF5130
600   I=ITEST                                                           COF5140
      ITEST=IGOOD                                                       COF5150
      IGOOD=I                                                           COF5160
      NSTOP=0                                                           COF5170
      REWIND ITEST                                                      COF5180
610   CONTINUE                                                          COF5190
      RETURN                                                            COF5200
C                                                                       COF5210
620   FORMAT (1H1,//,9X,20HSECTIONAL PROPERTIES,/,9X,20H****************COF5230
     1****,//,9X,38HI      CL         CM         CD         CT,/,9X,38H*    COF5240
     2 **         **         **         **,/,(I10,4F10.5))               COF5250
630   FORMAT (1H ,/,9X,23HTOTAL LIFT COEFFICIENT=,F10.5,/,9X,34HTOTAL PICOF5260
     1TCHING MOMENT COEFFICIENT=,F10.5,/,9X,23HTOTAL DRAG COEFFICIENT=,FCOF5270
     210.5,/,9X,25HTOTAL THRUST COEFFICIENT=,F10.5)                     COF5280
640   FORMAT (1H ,//,34H SPANWISE PRESSURE AT CONSTANT X=,F10.5,/,8X,25HCOF5290
     1Y    2Y/B(LOCAL) DELTA-CP,/,(1X,2F10.5,2X,F10.5))                 COF5300
650   FORMAT (1H1,//,5X,21HDELTA-CP DISTRIBUTION,/,5X,21H***************COF5310
     1******,/,30H      X/C      2Y/B   DELTA-CP,/,30H      ***      ***COF5320
     2*   ********)                                                     COF5330
660   FORMAT (1H ,3F10.5)                                               COF5340
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      END                                                               COF5350-


      SUBROUTINE INTGMY (NCW,NSW1,SGM,SNN,COEF,F,THETA)                 INT  10
C     SETS UP COEFFICIENTS OF A MATRIX FOR DCP-INTERPOLATION            INT  20
      DIMENSION SGM(1), SNN(1), F(1), THETA(1), COEF(NSW1,1)            INT  30
      PI=3.14159265                                                     INT  40
      N1=NCW+1                                                          INT  50
      FN=NCW                                                            INT  60
      DO 40 I=1,NSW1                                                    INT  70
      DO 10 J=1,NCW                                                     INT  80
      NK=(I-1)*NCW+J                                                    INT  90
      FJ=J                                                              INT 100
      THETA(J)=(2.*FJ-1.)*PI/(2.*FN)                                    INT 110
10    F(J)=SGM(NK)*SNN(J)                                               INT 120
      DO 30 J=1,N1                                                      INT 130
      COEF(I,J)=0.                                                      INT 140
      FJ=J                                                              INT 150
      DO 20 K=1,NCW                                                     INT 160
20    COEF(I,J)=COEF(I,J)+F(K)*COS((FJ-1.)*THETA(K))                    INT 170
      IF (J.EQ.1) COEF(I,J)=COEF(I,J)/FN                                INT 180
      IF (J.NE.1) COEF(I,J)=COEF(I,J)*2./FN                             INT 190
30    CONTINUE                                                          INT 200
40    CONTINUE                                                          INT 210
      RETURN                                                            INT 220
      END                                                               INT 230-


      SUBROUTINE SURFSET (N3,X,Y,W,IWK)                                 SRF  10
C       SET UP PROGRAM FOR SURFACE SPLINE                               SRF  20
C       WRITTEN BY - ROBERT N. DESMARAIS, STRUCTURES AND DYNAMICS DIV.  SRF  30
C                    LANGLEY RESEARCH CENTER, HAMPTON, VA.23665         SRF  40
      DIMENSION X(1), Y(1), W(N3,1), IWK(1)                             SRF  50
      E=1.E-10                                                          SRF  60
      NZ=1                                                              SRF  70
      N=N3-3                                                            SRF  80
      N1=N+1                                                            SRF  90
      N2=N+2                                                            SRF 100
      N4=N3+1                                                           SRF 110
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```
      RN=1./N                                                           SRF 120
      N3Z=N3+NZ                                                         SRF 130
      NZ3=NZ+3                                                          SRF 140
C       COMPUTE SCALING PARAMETERS, UB,UX,UY,VB,VX,XY                   SRF 150
      XB=0.                                                             SRF 160
      YB=0.                                                             SRF 170
      PXX=0.                                                            SRF 180
      PXY=0.                                                            SRF 190
      PYY=0.                                                            SRF 200
      TH=0.                                                             SRF 210
      DO 10 I=1,N                                                       SRF 220
      XB=XB+X(I)                                                        SRF 230
      YB=YB+Y(I)                                                        SRF 240
      PXX=PXX+X(I)*X(I)                                                 SRF 250
      PXY=PXY+X(I)*Y(I)                                                 SRF 260
10    PYY=PYY+Y(I)*Y(I)                                                 SRF 270
      XB=RN*XB                                                          SRF 280
      YB=RN*YB                                                          SRF 290
      PXX=RN*PXX-XB*XB                                                  SRF 300
      PXY=RN*PXY-XB*YB                                                  SRF 310
      PYY=RN*PYY-YB*YB                                                  SRF 320
      IF (PXY.NE.0) TH=.5*ATAN2(2.*PXY,PYY-PXX)                         SRF 330
      CT=COS(TH)                                                        SRF 340
      ST=SIN(TH)                                                        SRF 350
      C2=CT*CT                                                          SRF 360
      CS=2.*CT*ST                                                       SRF 370
      S2=ST*ST                                                          SRF 380
      SU=1./SQRT(PXX*C2-PXY*CS+PYY*S2)                                  SRF 390
      SV=1./SQRT(PXX*S2+PXY*CS+PYY*C2)                                  SRF 400
      UX=SU*CT                                                          SRF 410
      UY=-SU*ST                                                         SRF 420
      VX=SV*ST                                                          SRF 430
      VY=SV*CT                                                          SRF 440
      UB=-(UX*XB+UY*YB)                                                 SRF 450
      VB=-(VX*XB+VY*YB)                                                 SRF 460
C       PUT Z INTO ITS W LOCATION                                       SRF 470
      IZ=N*NZ                                                           SRF 480
      DO 30 J=N4,N3Z                                                    SRF 490
      DO 20 I=1,3                                                       SRF 500
20    W(I,J)=0                                                          SRF 510
      DO 30 I=4,N3                                                      SRF 520
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      W(I,N37+N4-J)=W(IZ,1)                                             SRF 530
30    IZ=IZ-1                                                           SRF 540
C       PUT 1,U,V (SCALED X,Y) INTO THEIR W LOCATIONS                   SRF 550
      DO 40 J=N1,N3                                                     SRF 560
      DO 40 I=1,3                                                       SRF 570
40    W(I,J)=0                                                          SRF 580
      DO 50 J=1,N                                                       SRF 590
      JB=N4-J                                                           SRF 600
      W(1,J)=1.                                                         SRF 610
      W(JB,N1)=W(1,J)                                                   SRF 620
      W(2,J)=UB+UX*X(J)+UY*Y(J)                                         SRF 630
      W(JB,N2)=W(2,J)                                                   SRF 640
      W(3,J)=VB+VX*X(J)+VY*Y(J)                                         SRF 650
50    W(JB,N3)=W(3,J)                                                   SRF 660
      DO 60 J=1,N                                                       SRF 670
      JB=N4-J                                                           SRF 680
C       COMPUTE H MATRIX IN W                                           SRF 690
      DO 60 I=4,JB                                                      SRF 700
      IB=N4-I                                                           SRF 710
      R2=(W(2,J)-W(2,IB))**2+(W(3,J)-W(3,IB))**2                        SRF 720
      W(I,J)=R2*ALOG(R2+E)                                              SRF 730
60    W(JB,IB)=W(I,J)                                                   SRF 740
C      MATOPS IS THE SYSTEM LIBRARY ROUTINE FOR SOLVING LINEAR EQUATIONSSRF 750
      N31=N3+1                                                          SRF 760
      CALL MATINV (N3,N3,W,1,W(1,N31),1,DET,ISC,IWK,IWK(N4))            SRF 770
C       PUT S,U,V IN LOW W                                              SRF 780
      W(1,1)=N3*(3.+NZ)                                                 SRF 790
      W(2,1)=N                                                          SRF 800
      W(3,1)=E                                                          SRF 810
      DO 70 I=1,N                                                       SRF 820
      W(I+3,1)=0                                                        SRF 830
      W(I,2)=UB+UX*X(I)+UY*Y(I)                                         SRF 840
70    W(I,3)=VB+VX*X(I)+VY*Y(I)                                         SRF 850
      W(N1,2)=UB                                                        SRF 860
      W(N2,2)=UX                                                        SRF 870
      W(N3,2)=UY                                                        SRF 880
      W(N1,3)=VB                                                        SRF 890
      W(N2,3)=VX                                                        SRF 900
      W(N3,3)=VY                                                        SRF 910
      IF (NZ.EQ.0) RETURN                                               SRF 920
      DO 80 J=4,NZ3                                                     SRF 930
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      DO 80 I=1,N3                                                      SRF 940
C       LEFT SHIFT A,B MATRICES N COLUMNS                               SRF 950
80    W(I,J)=W(I,N+J)                                                   SRF 960
      RETURN                                                            SRF 970
      END                                                               SRF 980-


      SUBROUTINE SUPFORD (W,XP,YP,ZP,N3)                                FRD  10
C       SUPFACE SPLINE INTERPOLATION (ORDINATES)                        FRD  20
C       WRITTEN BY - ROBERT N. DESMARAIS, STRUCTURES AND DYNAMICS DIV.  FRD  30
C                    LANGLEY RESEARCH CENTER, HAMPTON, VA.23665         FRD  40
      DIMENSION W(N3,1)                                                 FRD  50
      N=N3-3                                                            FRD  60
      N1=N+1                                                            FRD  70
      N2=N+2                                                            FRD  80
      U=W(N1,2)+W(N2,2)*XP+W(N3,2)*YP                                   FRD  90
      V=W(N1,3)+W(N2,3)*XP+W(N3,3)*YP                                   FRD 100
      ZP=W(N1,4)+W(N2,4)*U+W(N3,4)*V                                    FRD 110
      DO 10 I=1,N                                                       FRD 120
      R2=(U-W(I,2))**2+(V-W(I,3))**2                                    FRD 130
10    ZP=ZP+W(I,4)*R2*ALOG(R2+W(3,1))                                   FPD 140
      RETURN                                                            FRD 150
      END                                                               FRD 160-


      SUBROUTINE MATINV (MAX,N,A,M,B,IOP,DETERM,ISCALE,IPIVOT,IWK)      MAT  10
C     MATRIX INVERSION WITH ACCOMPANYING SOLUTION OF LINEAR EQUATIONS   MAT  20
C     PROVIDED BY - ANALYSIS AND COMPUTATION DIVISION                   MAT  30
C                   LANGLEY RESEARCH CENTER                             MAT  40
C                   HAMPTON, VA. 23665                                  MAT  50
      DIMENSION IPIVOT(N), A(MAX,N), B(MAX,N), IWK(MAX,2)               MAT  60
      EQUIVALENCE (IROW,JROW), (ICOLUM,JCOLUM), (AMAX,T,SWAP)           MAT  70
C                                                                       MAT  80
C     INITIALIZATION                                                    MAT  90
C                                                                       MAT 100
      ISCALE=0                                                          MAT 110
      R1=10.0**100                                                      MAT 120
      R2=1.0/R1                                                         MAT 130
      DETERM=1.0                                                        MAT 140
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      DO 10 J=1,N                                                       MAT 150
10    IPIVOT(J)=0                                                       MAT 160
      DO 370 I=1,N                                                      MAT 170
C                                                                       MAT 180
C     SEARCH FOR PIVOT ELEMENT                                          MAT 190
C                                                                       MAT 200
      AMAX=0.0                                                          MAT 210
      DO 60 J=1,N                                                       MAT 220
      IF (IPIVOT(J)-1) 20,60,20                                         MAT 230
20    DO 50 K=1,N                                                       MAT 240
      IF (IPIVOT(K)-1) 30,50,410                                        MAT 250
30    IF (ABS(AMAX)-ABS(A(J,K))) 40,50,50                               MAT 260
40    IROW=J                                                            MAT 270
      ICOLUM=K                                                          MAT 280
      AMAX=A(J,K)                                                       MAT 290
50    CONTINUE                                                          MAT 300
60    CONTINUE                                                          MAT 310
      IF (AMAX) 80,70,80                                                MAT 320
70    DETERM=0.0                                                        MAT 330
      ISCALE=0                                                          MAT 340
      GO TO 410                                                         MAT 350
80    IPIVOT(ICOLUM)=IPIVOT(ICOLUM)+1                                   MAT 360
C                                                                       MAT 370
C     INTERCHANGE ROWS TO PUT PIVOT ELEMENT ON DIAGONAL                 MAT 380
C                                                                       MAT 390
      IF (IROW-ICOLUM) 90,130,90                                        MAT 400
90    DETERM=-DETERM                                                    MAT 410
      DO 100 L=1,N                                                      MAT 420
      SWAP=A(IROW,L)                                                    MAT 430
      A(IROW,L)=A(ICOLUM,L)                                             MAT 440
100   A(ICOLUM,L)=SWAP                                                  MAT 450
      IF (M) 130,130,110                                                MAT 460
110   DO 120 L=1,M                                                      MAT 470
      SWAP=B(IROW,L)                                                    MAT 480
      B(IROW,L)=B(ICOLUM,L)                                             MAT 490
120   B(ICOLUM,L)=SWAP                                                  MAT 500
130   IWK(I,1)=IROW                                                     MAT 510
      IWK(I,2)=ICOLUM                                                   MAT 520
      PIVOT=A(ICOLUM,ICOLUM)                                            MAT 530
      IF (IOP.EQ.1) GO TO 270                                           MAT 540
      IF (PIVOT) 140,70,140                                             MAT 550
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C                                                                       MAT 560
C     SCALE THE DETERMINANT                                             MAT 570
C                                                                       MAT 580
140   PIVOTI=PIVOT                                                      MAT 590
      IF (ABS(DETERM)-R1) 170,150,150                                   MAT 600
150   DETERM=DETERM/R1                                                  MAT 610
      ISCALE=ISCALE+1                                                   MAT 620
      IF (ABS(DETERM)-R1) 200,160,160                                   MAT 630
160   DETERM=DETERM/R1                                                  MAT 640
      ISCALE=ISCALE+1                                                   MAT 650
      GO TO 200                                                         MAT 660
170   IF (ABS(DETERM)-R2) 180,180,200                                   MAT 670
180   DETERM=DETERM*R1                                                  MAT 680
      ISCALE=ISCALE-1                                                   MAT 690
      IF (ABS(DETERM)-R2) 190,190,200                                   MAT 700
190   DETERM=DETERM*R1                                                  MAT 710
      ISCALE=ISCALE-1                                                   MAT 720
200   IF (ABS(PIVOTI)-R1) 230,210,210                                   MAT 730
210   PIVOTI=PIVOTI/R1                                                  MAT 740
      ISCALE=ISCALE+1                                                   MAT 750
      IF (ABS(PIVOTI)-R1) 260,220,220                                   MAT 760
220   PIVOTI=PIVOTI/R1                                                  MAT 770
      ISCALE=ISCALE+1                                                   MAT 780
      GO TO 260                                                         MAT 790
230   IF (ABS(PIVOTI)-R2) 240,240,260                                   MAT 800
240   PIVOTI=PIVOTI*R1                                                  MAT 810
      ISCALE=ISCALE-1                                                   MAT 820
      IF (ABS(PIVOTI)-R2) 250,250,260                                   MAT 830
250   PIVOTI=PIVOTI*R1                                                  MAT 840
      ISCALE=ISCALE-1                                                   MAT 850
260   DETERM=DETERM*PIVOTI                                              MAT 860
C                                                                       MAT 870
C     DIVIDE PIVOT ROW BY PIVOT ELEMENT                                 MAT 880
C                                                                       MAT 890
270   IF (PIVOT) 280,70,280                                             MAT 900
280   A(ICOLUM,ICOLUM)=1.0                                              MAT 910
      DO 290 L=1,N                                                      MAT 920
290   A(ICOLUM,L)=A(ICOLUM,L)/PIVOT                                     MAT 930
      IF (M) 320,320,300                                                MAT 940
300   DO 310 L=1,M                                                      MAT 950
310   B(ICOLUM,L)=B(ICOLUM,L)/PIVOT                                     MAT 960
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C                                                                       MAT 970
C     REDUCE NON-PIVOT ROWS                                             MAT 980
C                                                                       MAT 990
320   DO 370 L1=1,N                                                     MAT1000
      IF (L1-ICOLUM) 330,370,330                                        MAT1010
330   T=A(L1,ICOLUM)                                                    MAT1020
      A(L1,ICOLUM)=0.0                                                  MAT1030
      DO 340 L=1,N                                                      MAT1040
340   A(L1,L)=A(L1,L)-A(ICOLUM,L)*T                                     MAT1050
      IF (M) 370,370,350                                                MAT1060
350   DO 360 L=1,M                                                      MAT1070
360   B(L1,L)=B(L1,L)-B(ICOLUM,L)*T                                     MAT1080
370   CONTINUE                                                          MAT1090
C                                                                       MAT1100
C     INTERCHANGE COLUMNS                                               MAT1110
C                                                                       MAT1120
      DO 400 I=1,N                                                      MAT1130
      L=N+1-I                                                           MAT1140
      IF (IWK(L,1)-IWK(L,2)) 380,400,380                                MAT1150
380   JROW=IWK(L,1)                                                     MAT1160
      JCOLUM=IWK(L,2)                                                   MAT1170
      DO 390 K=1,N                                                      MAT1180
      SWAP=A(K,JROW)                                                    MAT1190
      A(K,JROW)=A(K,JCOLUM)                                             MAT1200
      A(K,JCOLUM)=SWAP                                                  MAT1210
390   CONTINUE                                                          MAT1220
400   CONTINUE                                                          MAT1230
410   RETURN                                                            MAT1240
      END                                                               MAT1250-
```

```
      OVERLAY (LEVSP,5,0)                                               NSP  10
      PROGRAM NEWSHAP                                                   NSP  20
C     SETS UP DIMENSIONS FOR COMPUTING THE NEW LOCATIONS OF LEADING-EDGENSP  30
C     AND TRAILING-EDGE VORTICES BY MAKING THOSE FORCE-FREE             NSP  40
      COMMON D(1)                                                       NSP  50
      COMMON /ALLI/ NSW,NSW1,NCW,NWNG,NCPTTL                            NSP  60
      COMMON /ABC/ PXE(10,40),PYE(10,40),PZE(10,40),PXXE(11,20),        NSP  70
     1PYYE(11,20),PZZE(11,20),NMAX,NNMAX,NCONTS                         NSP  80
      LC=1                                                              NSP  90
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      LTHETP=LC+NSW1                                                    NSP 100
      LXN=LTHETP+NSW1                                                   NSP 110
      LYN=LXN+2*NWNG                                                    NSP 120
      LXTE=LYN+2*NWNG                                                   NSP 130
      LXLE=LXTE+NSW                                                     NSP 140
      LYLE=LXLE+NSW                                                     NSP 150
      LCONS=LYLE+NSW                                                    NSP 160
      LSI=LCONS+NSW1                                                    NSP 170
      LXCP=LSI+NCW                                                      NSP 180
      LYCP=LXCP+NCPTTL                                                  NSP 190
      LCI=LYCP+NCPTTL                                                   NSP 200
      LCJ=LCI+NWNG                                                      NSP 210
      LCK=LCJ+NWNG                                                      NSP 220
      LCONI=LCK+NWNG                                                    NSP 230
      LCONJ=LCONI+NWNG                                                  NSP 240
      LCONK=LCONJ+NWNG                                                  NSP 250
      LDUMY=LCONK+NWNG                                                  NSP 260
      LGAMA=LDUMY+8*NWNG                                                NSP 270
      LGML=LGAMA+NCPTTL                                                 NSP 280
      LYLM=LGML+NSW1                                                    NSP 290
      LCPCW=LYLM+NSW1                                                   NSP 300
      LNEXT=LCPCW+NSW1                                                  NSP 310
C     LNEXT=21*NWNG+14*NSW+NCW-9                                        NSP 320
      CALL NEWELM (D(LC),D(LTHETP),D(LXN),D(LYN),D(LXTE),D(LXLE),D(LYLE)NSP 330
     1,D(LCONS),D(LSI),D(LXCP),D(LYCP),D(LCI),D(LCJ),D(LCK),D(LCONI),D(LNSP 340
     2CONJ),D(LCONK),D(LDUMY),NWNG,NCPTTL,NSW1,NSW,NCW,D(LGAMA),D(LGML),NSP 350
     3D(LYLM),D(LCPCW))                                                 NSP 360
      RETURN                                                            NSP 370
      END                                                               NSP 380-


      SUBROUTINE NEWELM (C,THETP,XN,YN,XTE,XLE,YLE,CONS,SI,XCP,YCP,CI,CJNLM  10
     1,CK,CONI,CONJ,CONK,DUMMY,NWNG,NCPTTL,NSW1,NSW,NCW,GAMA,GML,YLM,CPCNLM  20
     2W1)                                                               NLM  30
C     COMPUTES THE NEW LOCATIONS OF LEADING-EDGE AND TRAILING-EDGE      NLM  40
C     VORTICES BY MAKING THOSE FORCE-FREE                               NLM  50
      COMMON /INDEX/ IND                                                NLM  60
      COMMON /GM/ ITER                                                  NLM  70
      COMMON /LOC/ FU1,FU2,XEND,PXL(5),PXT(5),PYL(5),ICL                NLM  80
      COMMON /GENCF/ M1(5),NW(2),YBREAK(5),CH(90),SJ(31,3),MJW1(2),     NLM  90
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1MJW2(2),WIDTH(5),SWEEP(60),NTS,NC                                      NLM 100
 COMMON /LANDA/ FGMA1,FBDA1,FGMA,CLS                                    NLM 110
 COMMON/CAMB/ ICAM,IM(10),XT(10,21),AAM(10,20),BBM(10,20),              NLM 120
1CCM(10,20),DDM(10,20),YT(10),ZBDX(200),ZBDXV(200)                      NLM 130
 COMMON /TIPVX/ XTIP(15,30),YTIP(15,30),ZTIP(15,30),NTLM(15),NTMAX      NLM 140
 COMMON /NCTT/ NCT,NCON,NBT,NCOR(15),KU1,NFSH(15),KUC                   NLM 150
 COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40),XXE(11,20),                 NLM 160
1YYE(11,20),ZZE(11,20),NMAX,NNMAX,NCONTS                                NLM 170
 COMMON /OABC/ DXE(10,40),DYE(10,40),DZE(10,40)                         NLM 180
 COMMON /ALLRB/ AX(210),ZMIN,NELM(11),NNELM(12)                         NLM 190
 COMMON /LOCSP/ FTANTY(10,15),FTANTZ(10,15),CTANTY(40,2),CTANTZ(40,NLM 200
12)                                                                     NLM 210
 COMMON /INFAV/ FYT(20),FZT(20),FYI(40),FZI(40),VXI(40),VYI(40),VZINLM 220
1(40),FXT(20),TFORCE(20)                                                NLM 230
 COMMON /MDFAV/ FYP(40,2,2),FZP(40,2,2)                                 NLM 240
 COMMON /ALLRA/ TTL(16),ALPHA,SINA,AA(9),PI,AB(2),HALFB,AREA            NLM 250
 COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                     NLM 260
 COMMON /XSTN/ XBRR(25)                                                 NLM 270
 DIMENSION DUMMY(1), CONI(1), CONJ(1), CONK(1), CI(1), CJ(1), CK(1)NLM 280
1, C(1), THETP(1), XTE(1), XLE(1), YLE(1), CONS(1), SI(1), XCP(1), NLM 290
2YCP(1), GAMA(1), GML(1), YLM(1), CPCW1(1), XN(NWNG,2), YN(NWNG,2),NLM 300
3A(3),B(3),F(3)                                                         NLM 310
 DIMENSION FTX(10,10),FTY(10,10),FTZ(10,10),SFBDA(40,2),SFGMA(40,2)NLM 320
 COMMON /COEFF/ CL,FZMINS(10),FHS(2,10),RATIOS(2,10),                   NLM 330
1CFCORE(2,10),RATIOC(2,10)                                              NLM 340
 DIMENSION GT(10),GA(3),XB(40,2),YB(40,2),ZB(40,2)                      NLM 350
 DIMENSION FSIN(4),XE1(10,40),YE1(10,40),ZE1(10,40)                     NLM 360
 DIMENSION XE2(10,40),YE2(10,40),ZE2(10,40),TOS(15)                     NLM 370
C ..........................................................................NLM 380
 REWIND 1                                                               NLM 390
 CALL SKIPR (1,7)                                                       NLM 400
 READ (1) (C(I),I=1,NSW1)                                               NLM 410
 READ (1) (THETP(I),I=1,NSW1)                                           NLM 420
 READ (1) (XTE(I),XLE(I),YLE(I),I=1,NSW)                                NLM 430
 READ (1) (XLM,YLM(I),I=1,NSW1)                                         NLM 440
 READ (1) (CONS(I),I=1,NSW1)                                            NLM 450
 READ (1) (SI(I),AC,I=1,NCW)                                            NLM 460
 READ (1) (XCP(I),YCP(I),I=1,NCPTTL)                                    NLM 470
 READ (1) ((XN(I,J),YN(I,J),J=1,2),I=1,NWNG)                            NLM 480
 CALL SKIPR (1,2)                                                       NLM 490
 READ (1) (CPCW1(I),I=1,NCW)                                            NLM 500
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      REWIND 2                                                          NLM 510
      READ (2) (GAMA(I),I=1,NCPTTL)                                     NLM 520
      REWIND 3                                                          NLM 530
      READ (3) (GML(I),I=1,NSW1)                                        NLM 540
      BHALF=1.25*HALFB                                                  NLM 550
      ATL=1.-0.1*FLOAT(ITER)                                            NLM 560
      IF (NCONTS.NE.0) ATL=0.75                                         NLM 570
      IF (ATL.LT.0.75) ATL=0.75                                         NLM 580
      BTL=1.-ATL                                                        NLM 590
      IF (ITER.LE.KU1) GO TO 70                                         NLM 600
      KU5=KU1+1                                                         NLM 610
      KU6=KU1+2                                                         NLM 620
      KU7=KU1+3                                                         NLM 630
      NSW1=MAXL                                                         NLM 640
      DO 20 I=1,NSW1                                                    NLM 650
      GT(I)=0.                                                          NLM 660
      K1=1                                                              NLM 670
      IF (ITRAKE.NE.1.AND.I.GE.M1(1)) K1=M1(1)                          NLM 680
10    GT(I)=GT(I)+GAMA(NWNG+K1)                                         NLM 690
      K1=K1+1                                                           NLM 700
      IF (K1.GT.I) GO TO 20                                             NLM 710
      GO TO 10                                                          NLM 720
20    CONTINUE                                                          NLM 730
C     COMPUTATIONS OF RELAXATION PARAMETERS FOR THE CORE  MODEL         NLM 740
      ALPA=ALPHA*180./PI                                                NLM 750
      ALPHB=ALPHA                                                       NLM 760
      IF (ALPA.LT.10.) ALPHB=10.*PI/180.                                NLM 770
      IF (ITER.EQ.KU5) GO TO 30                                         NLM 780
      IF (ITER.EQ.KU6) GO TO 40                                         NLM 790
      IF (ITER.GE.KU7) GO TO 70                                         NLM 800
30    CONTINUE                                                          NLM 810
      FBDA=0.                                                           NLM 820
      FGMA=0.                                                           NLM 830
      IF (CL.GT.CLS) FBDA=-(CL-CLS)*SIN(ALPHA)/CLS                      NLM 840
      FBDA=2.*FBDA                                                      NLM 850
      IF (CL.LT.CLS) FGMA=-1.5*(CLS-CL)/(CLS*TAN(ALPHB))                NLM 860
      IF (CL.LT.CLS.AND.ALPA.LT.20..AND.ALPA.GE.10.) FGMA=0.5*FGMA      NLM 870
      IF (CL.LT.CLS.AND.ALPA.LT.10.) FGMA=0.50*FGMA                     NLM 880
      FGMA1=FGMA                                                        NLM 890
      GO TO 60                                                          NLM 900
40    CONTINUE                                                          NLM 910
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      FBDA=0.                                                           NLM 920
      FGMA=0.                                                           NLM 930
      FGMA1=0.                                                          NLM 940
      IF (ICL.EQ.1) GO TO 50                                            NLM 950
      FBDA=-(CL-CLS)*SIN(ALPHA)/CLS                                     NLM 960
      GO TO 60                                                          NLM 970
50    FGMA=0.75*(CL-CLS)/(CLS*TAN(ALPHB))                               NLM 980
      FGMA1=FGMA                                                        NLM 990
60    CONTINUE                                                          NLM1000
      IF (CL.GT.CLS) CONST=FBDA                                         NLM1010
      IF (CL.LT.CLS) CONST=FGMA1                                        NLM1020
      IF (CL.GT.CLS) ICL=1                                              NLM1030
      IF (CL.LT.CLS) ICL=0                                              NLM1040
70    CONTINUE                                                          NLM1050
      IF (ITER.EQ.KU1) GO TO 220                                        NLM1060
      IF (ITER.GT.KU1) GO TO 260                                        NLM1070
C     DIFFUSED VORTEX FILAMENT MODEL                                    NLM1080
C     CALCULATION OF THE COORDINATES OF LEADING-EDGE ELEMENTS BY        NLM1090
C     SATISFYING FORCE-FREE CONDITION                                   NLM1100
      NBT=0                                                             NLM1110
      DO 120 J=5,NMAX                                                   NLM1120
      DO 120 I=2,MAXL                                                   NLM1130
      NCON=I                                                            NLM1140
      K=NELM(I)-1                                                       NLM1150
      IF (J.GT.K) GO TO 120                                             NLM1160
      XXX=XE(I,J+1)                                                     NLM1170
      YYY=YE(I,J+1)                                                     NLM1180
      ZZZ=ZE(I,J+1)                                                     NLM1190
      DLS=SQRT((XE(I,J+1)-XE(I,J))**2+(YE(I,J+1)-YE(I,J))**2+(ZE(I,J+1)-NLM1200
     1ZE(I,J))**2)                                                      NLM1210
      XEE=(XE(I,J)+XE(I,J+1))/2.                                        NLM1220
      YEE=(YE(I,J)+YE(I,J+1))/2.                                        NLM1230
      ZEE=(ZE(I,J)+ZE(I,J+1))/2.                                        NLM1240
      CALL NEWVEL (C,THETP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,CONI,CONNLM1250
     1J,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,CPCW1,XCP,YCP,GAMA,YNLM1260
     2LM)                                                               NLM1270
      UVW=SQRT(UU*UU+VV*VV+WW*WW)                                       NLM1280
      IF (J.EQ.5) GO TO 80                                              NLM1290
      VVA=ATL*VV/UVW                                                    NLM1300
      WWA=ATL*WW/UVW                                                    NLM1310
      DLY=VVA*DLS+BTL*(YE(I,J+1)-YE(I,J))                               NLM1320
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      DLZ=WWA*DLS+BTL*(ZE(I,J+1)-ZE(I,J))                                NLM1330
      GO TO 90                                                           NLM1340
80    CONTINUE                                                           NLM1350
      VVA=0.5*VV/UVW                                                     NLM1360
      WWA=0.5*WW/UVW                                                     NLM1370
      DLY=VVA*DLS+0.5*(YE(I,J+1)-YE(I,J))                                NLM1380
      DLZ=WWA*DLS+0.5*(ZE(I,J+1)-ZE(I,J))                                NLM1390
      GO TO 100                                                          NLM1400
90    CONTINUE                                                           NLM1410
      IF ((DLZ/DLS).GT.SINA) DLZ=DLS*SINA                                NLM1420
100   CONTINUE                                                           NLM1430
      YINT=YE(I,J)+DLY                                                   NLM1440
      ZINT=ZE(I,J)+DLZ                                                   NLM1450
      IF (YINT.LE.YE(2,5)) YINT=YE(2,5)                                  NLM1460
      IF (YINT.GE.BHALF) YINT=BHALF                                      NLM1470
      IF (ZINT.LE.ZMIN) ZINT=ZMIN                                        NLM1480
      DLY2=YINT-YE(I,J)                                                  NLM1490
      DLZ2=ZINT-ZE(I,J)                                                  NLM1500
      DLX22=DLS*DLS-DLY2*DLY2-DLZ2*DLZ2                                  NLM1510
      IF (DLX22.LE.0.) DLY2=DLY2/2.                                      NLM1520
      IF (DLX22.LE.0.) DLZ2=DLZ2/2.                                      NLM1530
      DLX2=SQRT(DLS*DLS-DLY2*DLY2-DLZ2*DLZ2)                             NLM1540
      XE(I,J+1)=XE(I,J)+DLX2                                             NLM1550
      YE(I,J+1)=YE(I,J)+DLY2                                             NLM1560
      ZE(I,J+1)=ZE(I,J)+DLZ2                                             NLM1570
      DX=XE(I,J+1)-XXX                                                   NLM1580
      DY=YE(I,J+1)-YYY                                                   NLM1590
      DZ=ZE(I,J+1)-ZZZ                                                   NLM1600
      J2=J+2                                                             NLM1610
      KP=K+1                                                             NLM1620
      IF (J2.GT.KP) GO TO 120                                            NLM1630
      DO 110 JK=J2,KP                                                    NLM1640
      XE(I,JK)=XE(I,JK)+DX                                               NLM1650
      YE(I,JK)=YE(I,JK)+DY                                               NLM1660
110   ZE(I,JK)=ZE(I,JK)+DZ                                               NLM1670
120   CONTINUE                                                           NLM1680
130   CONTINUE                                                           NLM1690
C     CALCULATION OF THE COORDINATES OF WAKE ELEMENTS BY SATISFYING      NLM1700
C     FORCE-FREE CONDITION                                               NLM1710
      NAERO=0                                                            NLM1720
      CTL=0.5                                                            NLM1730
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      DTL=1.-CTL                                                        NLM1740
      NCON=0                                                            NLM1750
      NBT=0                                                             NLM1760
      DO 160 J=1,NNMAX                                                  NLM1770
      DO 160 I=2,MAXW                                                   NLM1780
      NCT=I                                                             NLM1790
      K=NNELM(I)-1                                                      NLM1800
      IF (J.GT.K) GO TO 160                                             NLM1810
      XXX=XXE(I,J+1)                                                    NLM1820
      YYY=YYE(I,J+1)                                                    NLM1830
      ZZZ=ZZE(I,J+1)                                                    NLM1840
      WLS=SQRT((XXE(I,J+1)-XXE(I,J))**2+(YYE(I,J+1)-YYE(I,J))**2+(ZZE(I,NLM1850
     1J+1)-ZZE(I,J))**2)                                                NLM1860
      XEE=(XXE(I,J)+XXE(I,J+1))/2.                                      NLM1870
      YEE=(YYE(I,J)+YYE(I,J+1))/2.                                      NLM1880
      ZEE=(ZZE(I,J)+ZZE(I,J+1))/2.                                      NLM1890
      CALL NEWVEL (C,THETP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,CONI,CONNLM1900
     1J,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,CPCW1,XCP,YCP,GAMA,YNLM1910
     2LM)                                                               NLM1920
      UVW=SQRT(UU*UU+VV*VV+WW*WW)                                       NLM1930
      IF (J.EQ.1) GO TO 150                                             NLM1940
      VVA=CTL*VV/UVW                                                    NLM1950
      WWA=CTL*WW/UVW                                                    NLM1960
      DLY=VVA*WLS+DTL*(YYE(I,J+1)-YYE(I,J))                             NLM1970
      DLZ=WWA*WLS+DTL*(ZZE(I,J+1)-ZZE(I,J))                             NLM1980
      IF ((DLZ/WLS).GT.SINA) DLZ=WLS*SINA                               NLM1990
      YINT=YYE(I,J)+DLY                                                 NLM2000
      IF (YINT.LE.(YLE(2)/2.)) YINT=YLE(2)/2.                           NLM2010
      IF (YINT.GE.RHALF) YINT=RHALF                                     NLM2020
      DLY2=YINT-YYE(I,J)                                                NLM2030
      DLZ2=DLZ                                                          NLM2040
      DLX22=WLS*WLS-DLY2*DLY2-DLZ2*DLZ2                                 NLM2050
      IF (DLX22.LE.0.) DLY2=DLY2/2.                                     NLM2060
      IF (DLX22.LE.0.) DLZ2=DLZ2/2.                                     NLM2070
      DLX2=SQRT(WLS*WLS-DLY2*DLY2-DLZ2*DLZ2)                            NLM2080
      XXE(I,J+1)=XXE(I,J)+DLX2                                          NLM2090
      YYE(I,J+1)=YYE(I,J)+DLY2                                          NLM2100
      ZZE(I,J+1)=ZZE(I,J)+DLZ2                                          NLM2110
      DX=XXE(I,J+1)-XXX                                                 NLM2120
      DY=YYE(I,J+1)-YYY                                                 NLM2130
      DZ=ZZE(I,J+1)-ZZZ                                                 NLM2140
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      J2=J+2                                                            NLM2150
      KP=K+1                                                            NLM2160
      IF (J2.GT.KP) GO TO 150                                           NLM2170
      DO 140 JK=J2,KP                                                   NLM2180
      XXE(I,JK)=XXE(I,JK)+DX                                            NLM2190
      YYE(I,JK)=YYE(I,JK)+DY                                            NLM2200
140   ZZE(I,JK)=ZZE(I,JK)+DZ                                            NLM2210
150   CONTINUE                                                          NLM2220
160   CONTINUE                                                          NLM2230
C     CALCULATION OF THE COORDINATES OF TIP VORTICES BY SATISFING       NLM2240
C     FORCE FREE CONDITION                                              NLM2250
      IF ((PXT(NC+1)-PXL(NC+1)).EQ.0.) GO TO 210                        NLM2260
      CTL=0.5                                                           NLM2270
      DTL=1.-CTL                                                        NLM2280
      NCON=0                                                            NLM2290
      NBT=0                                                             NLM2300
      DO 190 J=1,NTMAX                                                  NLM2310
      DO 190 I=1,NCW                                                    NLM2320
      NCT=I                                                             NLM2330
      K=NTLM(I)-1                                                       NLM2340
      IF (J.GT.K) GO TO 190                                             NLM2350
      XXX=XTIP(I,J+1)                                                   NLM2360
      YYY=YTIP(I,J+1)                                                   NLM2370
      ZZZ=ZTIP(I,J+1)                                                   NLM2380
      TLS=SQRT((XTIP(I,J+1)-XTIP(I,J))**2+(YTIP(I,J+1)-YTIP(I,J))**2+(ZTNLM2390
     1IP(I,J+1)-ZTIP(I,J))**2)                                          NLM2400
      XEE=0.5*(XTIP(I,J+1)+XTIP(I,J))                                   NLM2410
      YEE=0.5*(YTIP(I,J+1)+YTIP(I,J))                                   NLM2420
      ZEE=0.5*(ZTIP(I,J+1)+ZTIP(I,J))                                   NLM2430
      CALL NEWVEL (C,THETP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,CONI,CONNLM2440
     1J,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,CPCW1,XCP,YCP,GAMA,YNLM2450
     2LM)                                                               NLM2460
      UVW=SQRT(UU**2+VV**2+WW**2)                                       NLM2470
      IF (J.EQ.1) GO TO 180                                             NLM2480
      VVA=CTL*VV/UVW                                                    NLM2490
      WWA=CTL*WW/UVW                                                    NLM2500
      DLY=VVA*TLS+DTL*(YTIP(I,J+1)-YTIP(I,J))                           NLM2510
      DLZ=WWA*TLS+DTL*(ZTIP(I,J+1)-ZTIP(I,J))                           NLM2520
      DLX=SQRT(TLS**2-DLY**2-DLZ**2)                                    NLM2530
      XTIP(I,J+1)=XTIP(I,J)+DLX                                         NLM2540
      YTIP(I,J+1)=YTIP(I,J)+DLY                                         NLM2550
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      ZTIP(I,J+1)=ZTIP(I,J)+DLZ                                         NLM2560
      IF (ZTIP(I,J+1).LE.0..AND.YTIP(I,J+1).LE.HALFB.AND.XTIP(I,J+1).LE.NLM2570
     1PXT(NC+1)) ZTIP(I,J+1)=ZMIN                                       NLM2580
      DX=XTIP(I,J+1)-XXX                                                NLM2590
      DY=YTIP(I,J+1)-YYY                                                NLM2600
      DZ=ZTIP(I,J+1)-ZZZ                                                NLM2610
      J2=J+2                                                            NLM2620
      KP=K+1                                                            NLM2630
      IF (J2.GT.KP) GO TO 180                                           NLM2640
      DO 170 JK=J2,KP                                                   NLM2650
      XTIP(I,JK)=XTIP(I,JK)+DX                                          NLM2660
      YTIP(I,JK)=YTIP(I,JK)+DY                                          NLM2670
170   ZTIP(I,JK)=ZTIP(I,JK)+DZ                                          NLM2680
180   CONTINUE                                                          NLM2690
190   CONTINUE                                                          NLM2700
      DO 200 I=1,NCW                                                    NLM2710
      KK=NTLM(I)                                                        NLM2720
      WRITE (6,740) (XTIP(I,J),J=1,KK)                                  NLM2730
      WRITE (6,740) (YTIP(I,J),J=1,KK)                                  NLM2740
      WRITE (6,740) (ZTIP(I,J),J=1,KK)                                  NLM2750
200   CONTINUE                                                          NLM2760
210   CONTINUE                                                          NLM2770
      RETURN                                                            NLM2780
220   CONTINUE                                                          NLM2790
C     DETERMINE THE INITIAL SHAPE OF FREE SHEET AND CORE FROM THE       NLM2800
C     ESTABLISHED LEADING-EDGE VORTEX FILAMENT SYSTEM                   NLM2810
      NSW1=MAXL                                                         NLM2820
      CALL CORE (XB,YB,ZB,XEND,GAMA,NSW1,NELM,NWNG,NXB)                 NLM2830
      CALL MODEL (XB,YB,ZB,NELM,NXB,M1,LASTE)                           NLM2840
      CALL LIRITN (NCOR,NELM,M1,LASTE)                                  NLM2850
      CALL APEXC (NELM,NCOR,M1)                                         NLM2860
      NSW1=MAXL                                                         NLM2870
      NSW=MAXW                                                          NLM2880
C     PUNCH CARDS FOR ANGLE OF ATTACK IS LESS THAN TWENTY DEGREES       NLM2890
      PUNCH 760, (NELM(I),I=1,NSW1)                                     NLM2900
      DO 230 I=1,NSW1                                                   NLM2910
      K=NELM(I)                                                         NLM2920
      PUNCH 750, (XE(I,J),J=1,K)                                        NLM2930
      PUNCH 750, (YE(I,J),J=1,K)                                        NLM2940
      PUNCH 750, (ZE(I,J),J=1,K)                                        NLM2950
230   CONTINUE                                                          NLM2960
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      PUNCH 760, (NNFLM(I),I=1,NSW)                                     NLM2970
      DO 240 I=1,NSW                                                    NLM2980
      K=NNELM(I)                                                        NLM2990
      PUNCH 750, (XXE(I,J),J=1,K)                                       NLM3000
      PUNCH 750, (YYE(I,J),J=1,K)                                       NLM3010
      PUNCH 750, (ZZF(I,J),J=1,K)                                       NLM3020
240   CONTINUE                                                          NLM3030
      IF ((PXT(NC+1)-PXL(NC+1)).EQ.0.) RETURN                           NLM3040
      PUNCH 760, (NTLM(I),I=1,NCW)                                      NLM3050
      DO 250 I=1,NCW                                                    NLM3060
      K=NTLM(I)                                                         NLM3070
      PUNCH 750, (XTIP(I,J),J=1,K)                                      NLM3080
      PUNCH 750, (YTIP(I,J),J=1,K)                                      NLM3090
      PUNCH 750, (ZTIP(I,J),J=1,K)                                      NLM3100
250   CONTINUE                                                          NLM3110
      RETURN                                                            NLM3120
260   CONTINUE                                                          NLM3130
C     VORTEX CORE MODEL                                                 NLM3140
      NAERO=1                                                           NLM3150
      CALL CFAEC (C,THETP,XN,YN,XTE,XLE,YLE,YLM,CONS,CONI,CONJ,CONK,DUMMNLM3160
     1Y,SI,NSW1,NCW,NWNG,CI,CJ,CK,CPCW1,XCP,YCP,GAMA,AREA,ITER,GT,1)    NLM3170
C     CALCULATION OF THE NEW LOCATIONS OF FREE SHEET SEGMENTS BY        NLM3180
C     SATISFING FORCE FREE CONDITION                                    NLM3190
      NAERO=0                                                           NLM3200
      DO 290 I=2,MAXL                                                   NLM3210
      IF (ITRAKE.NE.1.AND.I.EQ.M1(1)) GO TO 290                         NLM3220
      NCR2=NCOR(I)-2                                                    NLM3230
      DO 280 J=5,NCR2                                                   NLM3240
      A(1)=XE(I,J+1)-XE(I,J)                                            NLM3250
      A(2)=YE(I,J+1)-YE(I,J)                                            NLM3260
      A(3)=ZE(I,J+1)-ZE(I,J)                                            NLM3270
      IF (J.EQ.NCR2) GO TO 270                                          NLM3280
      FTANTY(I,J)=A(2)/A(1)                                             NLM3290
      FTANTZ(I,J)=A(3)/A(1)                                             NLM3300
      GO TO 280                                                         NLM3310
270   TOS(I)=A(3)                                                       NLM3320
280   CONTINUE                                                          NLM3330
290   CONTINUE                                                          NLM3340
      LL=1                                                              NLM3350
      L1=1                                                              NLM3360
      KS=2                                                              NLM3370
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      KE=M1(1)-1                                                        NLM3380
      GO TO 310                                                         NLM3390
300   LL=2                                                              NLM3400
      L1=M1(1)                                                          NLM3410
      KS=M1(1)+1                                                        NLM3420
      KE=MAXL                                                           NLM3430
310   CONTINUE                                                          NLM3440
      IF (ITRAKE.NE.1.AND.ITER.GE.KU7) GO TO 320                        NLM3450
      IF (ITER.EQ.KU5) GO TO 330                                        NLM3460
      IF (ITRAKE.EQ.1.AND.ITER.GE.KU7.AND.RATIOS(LL,ITER).LE.0.05) GO TONLM3470
     1 320                                                              NLM3480
      ATL=0.5                                                           NLM3490
      BTL=0.75                                                          NLM3500
      GO TO 340                                                         NLM3510
320   ATL=0.90                                                          NLM3520
      BTL=0.95                                                          NLM3530
      GO TO 340                                                         NLM3540
330   ATL=0.5                                                           NLM3550
      BTL=0.5                                                           NLM3560
340   CONTINUE                                                          NLM3570
      NCR2=NCOR(L1)-2                                                   NLM3580
      DO 430 J=5,NCR2                                                   NLM3590
      DO 420 I=KS,KE                                                    NLM3600
      GMA=GAMA(NWNG+I)                                                  NLM3610
      XXX=XE(I,J+1)                                                     NLM3620
      YYY=YE(I,J+1)                                                     NLM3630
      ZZZ=ZE(I,J+1)                                                     NLM3640
      NBT=0                                                             NLM3650
      NCON=I                                                            NLM3660
      XEE=0.5*(XE(I,J)+XE(I,J+1))                                       NLM3670
      YEE=0.5*(YE(I,J)+YE(I,J+1))                                       NLM3680
      ZEE=0.5*(ZE(I,J)+ZE(I,J+1))                                       NLM3690
      CALL NEWVEL (C,THETP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,CONI,CONNLM3700
     1J,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,CPCW1,XCP,YCP,GAMA,YNLM3710
     2LM)                                                               NLM3720
      A(1)=XE(I,J+1)-XE(I,J)                                            NLM3730
      A(2)=YE(I,J+1)-YE(I,J)                                            NLM3740
      A(3)=ZE(I,J+1)-ZE(I,J)                                            NLM3750
      DLS=SQRT(A(1)**2+A(2)**2+A(3)**2)                                 NLM3760
      GA(1)=GMA*A(1)/AREA                                               NLM3770
      GA(2)=GMA*A(2)/AREA                                               NLM3780
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      GA(3)=GMA*A(3)/AREA                                               NLM3790
      B(1)=UU                                                           NLM3800
      B(2)=VV                                                           NLM3810
      B(3)=WW                                                           NLM3820
      CALL CRSPRD (B,GA,F)                                              NLM3830
      FTX(I,J)=F(1)                                                     NLM3840
      FTY(I,J)=F(2)                                                     NLM3850
      FTZ(I,J)=F(3)                                                     NLM3860
      IF (I.EQ.KS.AND.LL.EQ.1) GO TO 420                                NLM3870
      IF (J.EQ.NCR2) GO TO 410                                          NLM3880
      TANTY=VV/UU                                                       NLM3890
      TANTZ=WW/UU                                                       NLM3900
      IF (J.EQ.5) GO TO 350                                             NLM3910
      TANTY=(1.-ATL)*TANTY+ATL*FTANTY(I,J)                              NLM3920
      TANTZ=(1.-ATL)*TANTZ+ATL*FTANTZ(I,J)                              NLM3930
      GO TO 360                                                         NLM3940
350   TANTY=(1.-BTL)*TANTY+BTL*FTANTY(I,J)                              NLM3950
      TANTZ=(1.-BTL)*TANTZ+BTL*FTANTZ(I,J)                              NLM3960
360   CONTINUE                                                          NLM3970
      DLX=DLS/SQRT(1.+TANTY**2+TANTZ**2)                                NLM3980
      DLY=DLX*TANTY                                                     NLM3990
      DLZ=DLX*TANTZ                                                     NLM4000
      XE(I,J+1)=XE(I,J)+DLX                                             NLM4010
      YE(I,J+1)=YE(I,J)+DLY                                             NLM4020
      ZE(I,J+1)=ZE(I,J)+DLZ                                             NLM4030
      IF (ITER.EQ.KU5) GO TO 380                                        NLM4040
      IF (ZE(I,J+1).LT.FZMINS(I).AND.J.EQ.5) GO TO 370                  NLM4050
      GO TO 380                                                         NLM4060
370   ZE(I,J+1)=FZMINS(I)                                               NLM4070
      DLZ=ZE(I,J+1)-ZZZ                                                 NLM4080
      DLY=SQRT(DLS**2-DLX**2-DLZ**2)                                    NLM4090
      YE(I,J+1)=YE(I,J)+DLY                                             NLM4100
380   CONTINUE                                                          NLM4110
      DX=XE(I,J+1)-XXX                                                  NLM4120
      DY=YE(I,J+1)-YYY                                                  NLM4130
      DZ=ZE(I,J+1)-ZZZ                                                  NLM4140
      J2=J+2                                                            NLM4150
      KP=NCOR(I)-1                                                      NLM4160
      IF (J2.GT.KP) GO TO 400                                           NLM4170
      DO 390 JK=J2,KP                                                   NLM4180
      XE(I,JK)=XE(I,JK)+DX                                              NLM4190
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      YE(I,JK)=YE(I,JK)+DY                                              NLM4200
      ZE(I,JK)=ZE(I,JK)+DZ                                              NLM4210
390   CONTINUE                                                          NLM4220
400   CONTINUE                                                          NLM4230
      GO TO 420                                                         NLM4240
410   NCR3=NCR2+1                                                       NLM4250
      XE(I,NCR3)=XE(I,NCR2)                                             NLM4260
      YE(I,NCR3)=YE(I,NCR2)                                             NLM4270
      ZE(I,NCR3)=ZE(I,NCR2)+TOS(I)                                      NLM4280
420   CONTINUE                                                          NLM4290
430   CONTINUE                                                          NLM4300
      IF (LL.EQ.2) GO TO 450                                            NLM4310
C     LINEAR INTERPOLATION                                              NLM4320
      RXE=(XE(KS,4)-PXL(LL))/(XE(KS+1,4)-PXL(LL))                       NLM4330
      RYE=(YE(KS,4)-PYL(LL))/(YE(KS+1,4)-PYL(LL))                       NLM4340
      NXOR=NCOR(KS)-1                                                   NLM4350
      DO 440 L=6,NXOR                                                   NLM4360
      XE(KS,L)=(XE(KS+1,L)-PXL(LL))*RXE+PXL(LL)                         NLM4370
      YE(KS,L)=(YE(KS+1,L)-PYL(LL))*RYE+PYL(LL)                         NLM4380
      ZE(KS,L)=ZE(KS+1,L)*RYE                                           NLM4390
440   CONTINUE                                                          NLM4400
450   CONTINUE                                                          NLM4410
      IF (ITRAKE.NE.1.AND.LL.EQ.1) GO TO 300                            NLM4420
      CALL NEWDA                                                        NLM4430
C     CALCULATION OF THE NEW LOCATIONS OF CONCENTRATED CORE BY          NLM4440
C     SATISFING THE FORCE FREE CONDITION                                NLM4450
      LL=1                                                              NLM4460
      L1=1                                                              NLM4470
      L3=L1+1                                                           NLM4480
      LMAX=M1(1)-1                                                      NLM4490
      KS=2                                                              NLM4500
      KE=LMAX                                                           NLM4510
      LO=L1-1                                                           NLM4520
      GO TO 470                                                         NLM4530
460   LL=2                                                              NLM4540
      L1=M1(1)                                                          NLM4550
      L3=L1+1                                                           NLM4560
      LMAX=MAXL                                                         NLM4570
      KS=M1(1)+1                                                        NLM4580
      KE=LMAX                                                           NLM4590
      LO=L1-1                                                           NLM4600
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470   CONTINUE                                                          NLM4610
      FSMIN=FHS(LL,ITER)                                                NLM4620
      NAERO=1                                                           NLM4630
      NFINAL=0                                                          NLM4640
      CALL CFAEC (C,THETP,XN,YN,XTE,XLE,YLE,YLM,CONS,CONI,CONJ,CONK,DUMMNLM4650
     1Y,SI,NSW1,NCW,NWNG,CI,CJ,CK,CPCW1,XCP,YCP,GAMA,AREA,ITER,GT,2)    NLM4660
      IF (ITER.EQ.KU5.OR.ITER.EQ.KU6) GO TO 480                         NLM4670
      A1=TFORCE(LL)                                                     NLM4680
      B1=TFORCE(LL)                                                     NLM4690
      CALL SEGMNT (A1,B1,NELM,NCOR,SFGMA,SFBDA)                         NLM4700
480   CONTINUE                                                          NLM4710
490   CONTINUE                                                          NLM4720
      NCT=0                                                             NLM4730
      NFINAL=NFINAL+1                                                   NLM4740
      FACTOR=1.0                                                        NLM4750
      IF (ITER.GE.KU7.AND.RATIOC(LL,ITER).LT.0.05) FACTOR=0.1           NLM4760
      NAERO=1                                                           NLM4770
      NSW5=NELM(L1)-NCOR(L1)                                            NLM4780
      DO 570 I=1,NSW5                                                   NLM4790
      IF (I.EQ.1) GO TO 570                                             NLM4800
      II=NCOR(L1)+I                                                     NLM4810
      NCON=LO+I                                                         NLM4820
      IF (NCON.GE.LMAX) NCON=LMAX                                       NLM4830
      NBT=1                                                             NLM4840
      XXX=XE(L1,II)                                                     NLM4850
      YYY=YE(L1,II)                                                     NLM4860
      ZZZ=ZE(L1,II)                                                     NLM4870
      XEE=0.5*(XE(L1,II-1)+XE(L1,II))                                   NLM4880
      YEE=0.5*(YE(L1,II-1)+YE(L1,II))                                   NLM4890
      ZEE=0.5*(ZE(L1,II-1)+ZE(L1,II))                                   NLM4900
      GMA=GT(NCON)                                                      NLM4910
      A(1)=XE(L1,II)-XE(L1,II-1)                                        NLM4920
      A(2)=YE(L1,II)-YE(L1,II-1)                                        NLM4930
      A(3)=ZE(L1,II)-ZE(L1,II-1)                                        NLM4940
      CALL NEWVEL (C,THETP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,CONI,CONNLM4950
     1J,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,CPCW1,XCP,YCP,GAMA,YNLM4960
     2LM)                                                               NLM4970
      GA(1)=GMA*A(1)/AREA                                               NLM4980
      GA(2)=GMA*A(2)/AREA                                               NLM4990
      GA(3)=GMA*A(3)/AREA                                               NLM5000
      B(1)=UU                                                           NLM5010
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      B(2)=VV                                                           NLM5020
      B(3)=WW                                                           NLM5030
      CALL CRSPRD (B,GA,F)                                              NLM5040
      FYI(I)=F(2)                                                       NLM5050
      FZI(I)=F(3)                                                       NLM5060
      IF (ITER.EQ.KU5.OR.ITER.EQ.KU6) GO TO 530                         NLM5070
      IF (NFINAL.EQ.1.OR.NFINAL.EQ.3) SIGN=1.0                          NLM5080
      IF (NFINAL.EQ.2.OR.NFINAL.EQ.4) SIGN=-1.0                         NLM5090
      GO TO (510,510,500,500), NFINAL                                   NLM5100
500   CONTINUE                                                          NLM5110
      FGMA1=SIGN*SFGMA(I,LL)                                            NLM5120
      FBDA=0.                                                           NLM5130
      CONST=FGMA1                                                       NLM5140
      GO TO 520                                                         NLM5150
510   FBDA=SIGN*SFBDA(I,LL)                                             NLM5160
      FGMA1=0.                                                          NLM5170
      CONST=FBDA                                                        NLM5180
520   CONTINUE                                                          NLM5190
530   CONTINUE                                                          NLM5200
      TANTY=CTANTY(I,LL)-FBDA*ABS(FZI(I))/(GA(1)*B(1))*FACTOR           NLM5210
      TANTZ=CTANTZ(I,LL)+FGMA1*ABS(FYI(I))/(GA(1)*B(1))*FACTOR          NLM5220
      DLS=SQRT(A(1)**2+A(2)**2+A(3)**2)                                 NLM5230
      DLX=DLS/SQRT(1.+TANTY**2+TANTZ**2)                                NLM5240
      DLY=DLX*TANTY                                                     NLM5250
      DLZ=DLX*TANTZ                                                     NLM5260
      XE(L1,II)=XE(L1,II-1)+DLX                                         NLM5270
      YE(L1,II)=YE(L1,II-1)+DLY                                         NLM5280
      ZE(L1,II)=ZE(L1,II-1)+DLZ                                         NLM5290
      IF (ZE(L1,II).LT.0.) ZE(L1,II)=ZMIN                               NLM5300
C      TO ADJUST THE ENTIRE CORE SIMULTANEOUSLY                         NLM5310
      IF (I.EQ.NSW5) GO TO 550                                          NLM5320
      DX=XE(L1,II)-XXX                                                  NLM5330
      DY=YE(L1,II)-YYY                                                  NLM5340
      DZ=ZE(L1,II)-ZZZ                                                  NLM5350
      KN=II+1                                                           NLM5360
      KK=NELM(L1)                                                       NLM5370
      DO 540 IL=KN,KK                                                   NLM5380
      XE(L1,IL)=XE(L1,IL)+DX                                            NLM5390
      YE(L1,IL)=YE(L1,IL)+DY                                            NLM5400
      ZE(L1,IL)=ZE(L1,IL)+DZ                                            NLM5410
540   CONTINUE                                                          NLM5420
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550   CONTINUE                                                          NLM5430
      DO 560 IK=L3,LMAX                                                 NLM5440
      NK=NELM(IK)                                                       NLM5450
      JK=NCOR(IK)                                                       NLM5460
      DO 560 L=JK,NK                                                    NLM5470
      XE(IK,L)=XE(IK-1,L+1)                                             NLM5480
      YE(IK,L)=YE(IK-1,L+1)                                             NLM5490
      ZE(IK,L)=ZE(IK-1,L+1)                                             NLM5500
560   CONTINUE                                                          NLM5510
570   CONTINUE                                                          NLM5520
      IF (ITRAKE.NE.1) GO TO 580                                        NLM5530
      IF (ITER.GT.KU6) GO TO 580                                        NLM5540
C     ADJUST THE 2ND END POINT OF THE FIRST CORE SEGMENT BY             NLM5550
C     LINEAR INTERPOLATION FROM THE THIRD POINT AND APEX.               NLM5560
      NXOR1=NCOR(L1)+1                                                  NLM5570
      NXOR2=NCOR(L1)+2                                                  NLM5580
      NXOR=NCOR(L1)                                                     NLM5590
      RY=(YE(L1,NXOR2)-PYL(LL))/(XE(L1,NXOR2)-PXL(LL))                  NLM5600
      RZ=(ZE(L1,NXOR2)-0.)/(XE(L1,NXOR2)-PXL(LL))                       NLM5610
      YE(L1,NXOR1)=RY*(XE(L1,NXOR1)-PXL(LL))+PYL(LL)                    NLM5620
      ZE(L1,NXOR1)=RZ*(XE(L1,NXOR1)-PXL(LL))                            NLM5630
      ZE(L1,NXOR1)=0.5*(ZE(L1,NXOR1)+ZE(L1,NXOR2))                      NLM5640
      YE(L1+1,NXOR)=YE(L1,NXOR1)                                        NLM5650
      ZE(L1+1,NXOR)=ZE(L1,NXOR1)                                        NLM5660
580   CONTINUE                                                          NLM5670
C     CHECK FREE SHEET AND CORE LOCATION AFTER CORE ADJUSTMENTS         NLM5680
C     NOTE THAT FIRST CORE SEGMENT FROM APEX IS COVERED BY FREE SHEET   NLM5690
      DO 600 II=KS,KE                                                   NLM5700
      NXOR=NCOR(II)                                                     NLM5710
      NCA=NCOR(II)-1                                                    NLM5720
      IF (YE(II,NXOR).LT.YE(II,NCA)) GO TO 590                          NLM5730
      GO TO 600                                                         NLM5740
590   NCB=NXOR-2                                                        NLM5750
      YE(II,NCA)=YE(II,NXOR)                                            NLM5760
      YE(II,NCB)=YE(II,NXOR)                                            NLM5770
600   CONTINUE                                                          NLM5780
      CALL CFAEC (C,THETP,XN,YN,XTE,XLE,YLE,YLM,CONS,CONI,CONJ,CONK,DUMMNLM5790
     1Y,SI,NSW1,NCW,NWNG,CI,CJ,CK,CPCW1,XCP,YCP,GAMA,AREA,ITER,GT,2)    NLM5800
      NCR2=NCOR(L1)-2                                                   NLM5810
      NAERO=0                                                           NLM5820
      FTX1=0.                                                           NLM5830
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      FTY1=0.                                                           NLM5840
      FTZ1=0.                                                           NLM5850
      FR123=0.                                                          NLM5860
      DO 610 J=5,NCR2                                                   NLM5870
      DO 610 I=KS,KE                                                    NLM5880
      GMA=GAMA(NWNG+I)                                                  NLM5890
      NBT=0                                                             NLM5900
      NCON=I                                                            NLM5910
      XEE=0.5*(XE(I,J)+XE(I,J+1))                                       NLM5920
      YEE=0.5*(YE(I,J)+YE(I,J+1))                                       NLM5930
      ZEE=0.5*(ZE(I,J)+ZE(I,J+1))                                       NLM5940
      CALL NEWVEL (C,THETP,XEE,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,CONI,CONNLM5950
     1J,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,CPCW1,XCP,YCP,GAMA,YNLM5960
     2LM)                                                               NLM5970
      A(1)=XE(I,J+1)-XE(I,J)                                            NLM5980
      A(2)=YE(I,J+1)-YE(I,J)                                            NLM5990
      A(3)=ZE(I,J+1)-ZE(I,J)                                            NLM6000
      GA(1)=GMA*A(1)/AREA                                               NLM6010
      GA(2)=GMA*A(2)/AREA                                               NLM6020
      GA(3)=GMA*A(3)/AREA                                               NLM6030
      B(1)=UU                                                           NLM6040
      B(2)=VV                                                           NLM6050
      B(3)=WW                                                           NLM6060
      CALL CRSPRD (B,GA,F)                                              NLM6070
      FTX1=FTX1+F(1)                                                    NLM6080
      FTY1=FTY1+F(2)                                                    NLM6090
      FTZ1=FTZ1+F(3)                                                    NLM6100
      FR123=FR123+SQRT(F(1)**2+F(2)**2+F(3)**2)                         NLM6110
610   CONTINUE                                                          NLM6120
      FSIN(NFINAL)=SQRT(FTX1**2+FTY1**2+FTZ1**2)                        NLM6130
      IF (ITER.GT.KU6) GO TO 620                                        NLM6140
      CALL NEWDA                                                        NLM6150
      GO TO 730                                                         NLM6160
620   CONTINUE                                                          NLM6170
C     COMPARE THE FREE SHEET FORCE AFTER EACH INNER CYCLE (+Y, -Y,      NLM6180
C     +Z, -Z) OF VORTEX CORE&S MOVEMENT                                 NLM6190
      IF (NFINAL.EQ.1.OR.NFINAL.EQ.3) GO TO 630                         NLM6200
      IF (NFINAL.EQ.2.OR.NFINAL.EQ.4) GO TO 650                         NLM6210
630   CONTINUE                                                          NLM6220
      DO 640 I=L1,LMAX                                                  NLM6230
      JK=NCOR(I)                                                        NLM6240
```

```
      NK=NELM(I)                                                        NLM6250
      DO 640 J=JK,NK                                                    NLM6260
      XE1(I,J)=XE(I,J)                                                  NLM6270
      YE1(I,J)=YE(I,J)                                                  NLM6280
      ZE1(I,J)=ZE(I,J)                                                  NLM6290
640   CONTINUE                                                          NLM6300
      CALL NEWBC (MAXL)                                                 NLM6310
      GO TO 490                                                         NLM6320
650   DO 660 I=L1,LMAX                                                  NLM6330
      JK=NCOR(I)                                                        NLM6340
      NK=NELM(I)                                                        NLM6350
      DO 660 J=JK,NK                                                    NLM6360
      XE2(I,J)=XE(I,J)                                                  NLM6370
      YE2(I,J)=YE(I,J)                                                  NLM6380
      ZE2(I,J)=ZE(I,J)                                                  NLM6390
660   CONTINUE                                                          NLM6400
      CALL NEWBC (MAXL)                                                 NLM6410
C     COMPARE THE FREE SHEET FORCE IN THE INNER ITERATION               NLM6420
      X1=FSIN(NFINAL-1)                                                 NLM6430
      X2=FSIN(NFINAL)                                                   NLM6440
      CALL MINMAX (X1,X2,XMN,XMX)                                       NLM6450
      IF (XMN.GT.FSMIN) GO TO 720                                       NLM6460
      IF (X2.LT.X1) ID=2                                                NLM6470
      IF (X1.LT.X2) ID=1                                                NLM6480
      IF (ID.EQ.2) GO TO 670                                            NLM6490
      GO TO 690                                                         NLM6500
670   DO 680 I=L1,LMAX                                                  NLM6510
      JK=NCOR(I)                                                        NLM6520
      NK=NELM(I)                                                        NLM6530
      DO 680 J=JK,NK                                                    NLM6540
      XE(I,J)=XE2(I,J)                                                  NLM6550
      YE(I,J)=YE2(I,J)                                                  NLM6560
      ZE(I,J)=ZE2(I,J)                                                  NLM6570
680   CONTINUE                                                          NLM6580
      GO TO 710                                                         NLM6590
690   DO 700 I=L1,LMAX                                                  NLM6600
      JK=NCOR(I)                                                        NLM6610
      NK=NELM(I)                                                        NLM6620
      DO 700 J=JK,NK                                                    NLM6630
      XE(I,J)=XE1(I,J)                                                  NLM6640
      YE(I,J)=YE1(I,J)                                                  NLM6650
```

```
      ZE(I,J)=ZE1(I,J)                                                  NLM6660
700   CONTINUE                                                          NLM6670
710   CONTINUE                                                          NLM6680
      IF (ID.EQ.1) FSMIN=X1                                             NLM6690
      IF (ID.EQ.2) FSMIN=X2                                             NLM6700
      CALL NEWDA                                                        NLM6710
720   CONTINUE                                                          NLM6720
      IF (NFINAL.EQ.4) GO TO 730                                        NLM6730
      GO TO 490                                                         NLM6740
730   CONTINUE                                                          NLM6750
      IF (ITRAKE.NE.1.AND.LL.EQ.1) GO TO 460                            NLM6760
      GO TO 130                                                         NLM6770
C                                                                       NLM6780
740   FORMAT (1H0,5X,8F10.5)                                            NLM6800
750   FORMAT (8F10.4)                                                   NLM6810
760   FORMAT (10I2)                                                     NLM6820
      END                                                               NLM6830-


      SUBROUTINE CORF (XB,YB,ZB,XEND,GAMA,NSW1,NELM,NWNG,NXB)           CRE  10
C     FIND THE CENTROID OF THE DIFFUSED LEADING-EDGE VORTEX             CRE  20
C     ELEMENT SYSTEM                                                    CRE  30
      DIMENSION XB(40,2),YB(40,2),ZB(40,2),GAMA(1),YSTN(40),ZSTN(40),   CRE  40
     1NELM(1)                                                           CRE  50
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40)                        CRE  60
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                CRE  70
      COMMON /GENCF/ M1(5)                                              CRE  80
      COMMON /LOC/ FU1,FU2,BEND,PXL(5),PXT(5),PYL(5)                    CRE  90
      SEGL=(PXT(1)-PXL(1))/8.                                           CRE 100
      IF (ITRAKE.NE.1) GO TO 10                                         CRE 110
      LL=1                                                              CRE 120
      L1=1                                                              CRE 130
      NSW2=NSW1-1                                                       CRE 140
      L2=2                                                              CRE 150
      ISECT=1                                                           CRE 160
      L3=L2                                                             CRE 170
      NSW1=MAXL                                                         CRE 180
      GO TO 30                                                          CRE 190
10    LL=1                                                              CRE 200
      L1=1                                                              CRE 210
```

```
      NSW2=(M1(1)-1)-1                                                  CRE 220
      L2=2                                                              CRE 230
      ISECT=1                                                           CRE 240
      L3=L2                                                             CRE 250
      NSW1=M1(1)-1                                                      CRE 260
      GO TO 30                                                          CRE 270
20    LL=2                                                              CRE 280
      L1=M1(1)                                                          CRE 290
      NSW2=(M1(1)-1)+(M1(2)-1)-1                                        CRE 300
      L2=L1+1                                                           CRE 310
      ISECT=2                                                           CRE 320
      L3=L1+1                                                           CRE 330
      NSW1=MAXL                                                         CRE 340
30    CONTINUE                                                          CRE 350
      XB(1,LL)=XE(L1,4)                                                 CRE 360
      YB(1,LL)=YE(L1,4)                                                 CRE 370
      ZB(1,LL)=ZE(L1,4)                                                 CRE 380
      II=1                                                              CRE 390
      DO 40 I=L2,NSW2                                                   CRE 400
      II=II+1                                                           CRE 410
      XB(II,LL)=0.5*(XE(I+1,4)+XE(I,4))                                 CRE 420
40    CONTINUE                                                          CRE 430
      K=II                                                              CRE 440
50    K=K+1                                                             CRE 450
      XB(K,LL)=XB(K-1,LL)+SEGL                                          CRE 460
      IF (XB(K,LL).LT.XEND) GO TO 50                                    CRE 470
      NXB=K                                                             CRE 480
      J=2                                                               CRE 490
60    XBAR=XB(J,LL)                                                     CRE 500
      CALL CENTRD (XBAR,YSTN,ZSTN,NMAX,NSW1,NFLM,ISECT)                 CRE 510
      SUMY=0.                                                           CRE 520
      SUMZ=0.                                                           CRE 530
      GMSUM=0.                                                          CRE 540
      DO 70 I=L3,NMAX                                                   CRE 550
      II=NWNG+I                                                         CRE 560
      GMSUM=GMSUM+GAMA(II)                                              CRE 570
      SUMY=SUMY+YSTN(I)*GAMA(II)                                        CRE 580
70    SUMZ=SUMZ+ZSTN(I)*GAMA(II)                                        CRE 590
      YBAR=SUMY/GMSUM                                                   CRE 600
      ZBAR=SUMZ/GMSUM                                                   CRE 610
      YB(J,LL)=YBAR                                                     CRE 620
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      ZB(J,LL)=ZBAR                                                     CRE 630
      J=J+1                                                             CRE 640
      IF (J.LE.NXB) GO TO 60                                            CRE 650
      IF (ITRAKE.NE.1.AND.LL.EQ.1) GO TO 20                             CRE 660
      RETURN                                                            CRE 670
      END                                                               CRE 680-


      SUBROUTINE CFAEC (C,THETP,XN,YN,XTE,XLE,YLE,YLM,CONS,CONI,CONJ,CONCFC  10
     1K,DUMMY,SI,NSW1,NCW,NWNG,CI,CJ,CK,CPCW1,XCP,YCP,GAMA,AREA,ITER,GT,CFC  20
     2N)                                                                CFC  30
      DIMENSION DUMMY(1),CONS(1),CONI(1),CONJ(1),CONK(1),CI(1),CJ(1),   CFC  40
     1CK(1),C(1),THETP(1),XLE(1),XTE(1),YLE(1),YLM(1),SI(1),GAMA(1),    CFC  50
     2XCP(1),YCP(1),CPCW1(1),XN(NWNG,2),YN(NWNG,2),A(3),B(3),F(3),GA(3),CFC  60
     3GT(3),FXP(40,2,2)                                                 CFC  70
      COMMON /NCTT/ NCT,NCON,NBT,NCOR(15)                               CFC  80
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40)                        CFC  90
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                CFC 100
      COMMON /ALLRB/ AX(210),ZMIN,NELM(11)                              CFC 110
      COMMON /GENCF/ M1(5)                                              CFC 120
      COMMON /MDFAV/ FYP(40,2,2),FZP(40,2,2)                            CFC 130
      COMMON /INFAV/ FYT(20),FZT(20),FYI(40),FZI(40),VXI(40),VYI(40),   CFC 140
     1VZI(40),FXT(20),TFORCE(20)                                        CFC 150
      NCT=0                                                             CFC 160
      LL=1                                                              CFC 170
      L1=1                                                              CFC 180
      L0=L1-1                                                           CFC 190
      L2=M1(1)-1                                                        CFC 200
      GO TO 20                                                          CFC 210
10    LL=2                                                              CFC 220
      L1=M1(1)                                                          CFC 230
      L0=L1-1                                                           CFC 240
      L2=MAXL                                                           CFC 250
20    CONTINUE                                                          CFC 260
      FXT(LL)=0.                                                        CFC 270
      FYT(LL)=0.                                                        CFC 280
      FZT(LL)=0.                                                        CFC 290
      NSW5=NELM(L1)-NCOR(L1)                                            CFC 300
      DO 30 I=1,NSW5                                                    CFC 310
      II=NCOR(L1)+I                                                     CFC 320
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      NCON=10+I                                                         CFC 330
      IF (NCON.GE.L2) NCON=L2                                           CFC 340
      NBT=1                                                             CFC 350
      XEE=0.5*(XE(L1,II-1)+XE(L1,II))                                   CFC 360
      YEE=0.5*(YE(L1,II-1)+YE(L1,II))                                   CFC 370
      ZEE=0.5*(ZE(L1,II-1)+ZE(L1,II))                                   CFC 380
      GMA=GT(NCON)                                                      CFC 390
      A(1)=XE(L1,II)-XE(L1,II-1)                                        CFC 400
      A(2)=YE(L1,II)-YE(L1,II-1)                                        CFC 410
      A(3)=ZE(L1,II)-ZE(L1,II-1)                                        CFC 420
      CALL NEWVEL (C,THETP,XEF,YEE,ZEE,XN,YN,XTE,YLE,CONS,DUMMY,CONI,CONCFC 430
     1J,CONK,SI,NSW1,NCW,NWNG,CI,CJ,CK,XLE,UU,VV,WW,CPCW1,XCP,YCP,GAMA,YCFC 440
     2LM)                                                               CFC 450
      GA(1)=GMA*A(1)/AREA                                               CFC 460
      GA(2)=GMA*A(2)/AREA                                               CFC 470
      GA(3)=GMA*A(3)/AREA                                               CFC 480
      B(1)=UU                                                           CFC 490
      B(2)=VV                                                           CFC 500
      B(3)=WW                                                           CFC 510
      CALL CRSPRD (B,GA,F)                                              CFC 520
      FXP(I,N,LL)=F(1)                                                  CFC 530
      FYP(I,N,LL)=F(2)                                                  CFC 540
      FZP(I,N,LL)=F(3)                                                  CFC 550
      FXT(LL)=FXT(LL)+F(1)                                              CFC 560
      FYT(LL)=FYT(LL)+F(2)                                              CFC 570
      FZT(LL)=FZT(LL)+F(3)                                              CFC 580
30    CONTINUE                                                          CFC 590
      TFORCE(LL)=SQRT(FXT(LL)**2+FYT(LL)**2+FZT(LL)**2)                 CFC 600
      IF (ITRAKE.NE.1.AND.LL.EQ.1) GO TO 10                             CFC 610
      RETURN                                                            CFC 620
      END                                                               CFC 630-


      SUBROUTINE SEGMNT (ASTAR,BSTAR,NELM,NCOR,SFGMA,SFBDA)             SEG  10
C     COMPUTE THE SEGMENT FORCE OF THE CORE                             SEG  20
      DIMENSION NELM(1),NCOR(1),SFBDA(40,2),SFGMA(40,2)                 SEG  30
      COMMON /MDFAV/ FYP(40,2,2),FZP(40,2,2)                            SEG  40
      COMMON /GENCF/ M1(5)                                              SEG  50
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                SEG  60
      LL=1                                                              SEG  70
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      L1=1                                                              SEG  80
      GO TO 20                                                          SEG  90
10    LL=2                                                              SEG 100
      L1=M1(1)                                                          SEG 110
20    CONTINUE                                                          SEG 120
      NSW5=NELM(L1)-NCOR(L1)                                            SEG 130
      DO 30 I=1,NSW5                                                    SEG 140
      IF (FZP(I,2,LL).GT.0..AND.FZP(I,1,LL).GT.0.) FZ=0.1               SEG 150
      IF (FZP(I,2,LL).LT.0..AND.FZP(I,1,LL).LT.0.) FZ=-0.1              SEG 160
      IF (FZP(I,2,LL).GT.0..AND.FZP(I,1,LL).LT.0.) FZ=0.1               SEG 170
      IF (FZP(I,2,LL).LT.0..AND.FZP(I,1,LL).GT.0.) FZ=-0.1              SEG 180
      SFGMA(I,LL)=FZ*(FZP(I,2,LL)-FZP(I,1,LL))/(ABS(FZP(I,1,LL)))*BSTAR SEG 190
      SFGMA(I,LL)=10.*SFGMA(I,LL)                                       SEG 200
      IF (FZP(I,2,LL)*FZP(I,1,LL).LT.0.) SFGMA(I,LL)=0.                 SEG 210
      IF (FYP(I,2,LL).GT.0..AND.FYP(I,1,LL).GT.0.) FY=0.5               SEG 220
      IF (FYP(I,2,LL).LT.0..AND.FYP(I,1,LL).LT.0.) FY=-0.5              SEG 230
      IF (FYP(I,2,LL).GT.0..AND.FYP(I,1,LL).LT.0.) FY=0.5               SEG 240
      IF (FYP(I,2,LL).LT.0..AND.FYP(I,1,LL).GT.0.) FY=-0.5              SEG 250
      SFBDA(I,LL)=FY*(FYP(I,2,LL)-FYP(I,1,LL))/(ABS(FYP(I,1,LL)))*ASTAR SEG 260
      IF (FYP(I,2,LL)*FYP(I,1,LL).LT.0.) SFBDA(I,LL)=-0.25*ABS((FYP(I,2,SEG 270
     1LL)-FYP(I,1,LL))/FYP(I,1,LL))                                     SEG 280
      IF (ABS(SFGMA(I,LL)).GT.1.0) SFGMA(I,LL)=0.                       SEG 290
      IF (ABS(SFBDA(I,LL)).GT.1.0) SFBDA(I,LL)=0.                       SEG 300
30    CONTINUE                                                          SEG 310
      IF (ITRAKE.NE.1.AND.LL.EQ.1) GO TO 10                             SEG 320
      RETURN                                                            SEG 330
      END                                                               SEG 340-


      SUBROUTINE NEWBC (NSW1)                                           NBC  10
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40)                        NBC  20
      COMMON /ALLBB/ AX(210),ZMIN,NELM(11)                              NBC  30
      COMMON /DABC/ DXE(10,40),DYE(10,40),DZE(10,40)                    NBC  40
      DO 20 I=1,NSW1                                                    NBC  50
      K=NELM(I)                                                         NBC  60
      DO 10 J=1,K                                                       NBC  70
      XE(I,J)=DXE(I,J)                                                  NBC  80
      YE(I,J)=DYE(I,J)                                                  NBC  90
      ZE(I,J)=DZE(I,J)                                                  NBC 100
10    CONTINUE                                                          NBC 110
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20    CONTINUE                                                          NBC 120
      RETURN                                                            NBC 130
      END                                                               NBC 140-


      SUBROUTINE NEWDA                                                  NDA  10
      DIMENSION A(3)                                                    NDA  20
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40)                        NDA  30
      COMMON /ALLRB/ AX(210),ZMIN,NELM(11)                              NDA  40
      COMMON /OABC/ DXE(10,40),DYE(10,40),DZE(10,40)                    NDA  50
      COMMON /GENCF/ M1(5)                                              NDA  60
      COMMON /AERO/ NAFRO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                NDA  70
      COMMON /LOCSP/ BX(300),CTANTY(40,2),CTANTZ(40,2)                  NDA  80
      COMMON /NCTT/ NCT,NCON,NBT,NCOR(15)                               NDA  90
      COMMON /MDFAV/ FYP(40,2,2),FZP(40,2,2)                            NDA 100
      DO 20 I=1,MAXL                                                    NDA 110
      K=NELM(I)                                                         NDA 120
      DO 10 J=1,K                                                       NDA 130
      DXE(I,J)=XE(I,J)                                                  NDA 140
      DYE(I,J)=YE(I,J)                                                  NDA 150
      DZE(I,J)=ZE(I,J)                                                  NDA 160
10    CONTINUE                                                          NDA 170
20    CONTINUE                                                          NDA 180
      LL=1                                                              NDA 190
      L1=1                                                              NDA 200
      GO TO 40                                                          NDA 210
30    LL=2                                                              NDA 220
      L1=M1(1)                                                          NDA 230
40    CONTINUE                                                          NDA 240
      NSW5=NELM(L1)-NCOR(L1)                                            NDA 250
      DO 50 I=1,NSW5                                                    NDA 260
      II=NCOR(L1)+I                                                     NDA 270
      A(1)=XE(L1,II)-XE(L1,II-1)                                        NDA 280
      A(2)=YE(L1,II)-YE(L1,II-1)                                        NDA 290
      A(3)=ZE(L1,II)-ZE(L1,II-1)                                        NDA 300
      CTANTY(I,LL)=A(2)/A(1)                                            NDA 310
      CTANTZ(I,LL)=A(3)/A(1)                                            NDA 320
50    CONTINUE                                                          NDA 330
      IF (ITRAKE.NE.1.AND.LL.EQ.1) GO TO 30                             NDA 340
      RETURN                                                            NDA 350
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      END                                                               NDA 360-


      SUBROUTINE MODEL (XB,YB,ZB,NELM,NXB,M1,LASTE)                     MOD  10
      DIMENSION M1(1)                                                   MOD  20
      DIMENSION XB(40,2),YB(40,2),ZB(40,2),                             MOD  30
     1FXE(10),FYE(10),FZE(10),BXE(10),BYE(10),BZE(10),NELM(1)           MOD  40
      COMMON /NCTT/ NCT,NCON,NBT,NCOR(15),KU1,NFSH(15)                  MOD  50
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                MOD  60
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40)                        MOD  70
      NSW1=MAXL                                                         MOD  80
      IF (ISPAN.EQ.0) IX=1                                              MOD  90
      IF (ISPAN.EQ.1) IX=2                                              MOD 100
      DO 110 I=2,NSW1                                                   MOD 110
      IF (ITRAKE.EQ.1) GO TO 10                                         MOD 120
      NN2=M1(1)+2                                                       MOD 130
      LL=0                                                              MOD 140
      IF (I.EQ.M1(1)-2) LL=1                                            MOD 150
      IF (I.EQ.NN2) LL=2                                                MOD 160
      IF (LL.EQ.0) GO TO 110                                            MOD 170
      GO TO 20                                                          MOD 180
10    LL=1                                                              MOD 190
20    CONTINUE                                                          MOD 200
      NIT=NFSH(I)                                                       MOD 210
      NN=NELM(I)                                                        MOD 220
      J=5                                                               MOD 230
30    IC=1                                                              MOD 240
      CALL CHOPS (LL,IC,I,J,XB,YB,ZB,NXB,NGB,FXE,FYE,FZE,XCA,XCB,ZCBMOD 250
     1)                                                                 MOD 260
      IF (NGP.EQ.1) GO TO 50                                            MOD 270
      IF ((J+1).EQ.NELM(I)) GO TO 40                                    MOD 280
      J=J+1                                                             MOD 290
      IF (J.LT.NN) GO TO 30                                             MOD 300
40    CONTINUE                                                          MOD 310
      ISF=0                                                             MOD 320
      WRITE (6,120)                                                     MOD 330
      LASTE=I                                                           MOD 340
      RETURN                                                            MOD 350
50    CONTINUE                                                          MOD 360
      XE(I,J+1)=FXE(I)                                                  MOD 370
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      YE(I,J+1)=FYE(I)                                                  MOD 380
      ZE(I,J+1)=FZE(I)                                                  MOD 390
      NOC=(J-4)+1                                                       MOD 400
      IF (NOC.GE.4) GO TO 90                                            MOD 410
      IF (NOC.EQ.2) GO TO 60                                            MOD 420
      IF (NOC.EQ.3) GO TO 80                                            MOD 430
60    DO 70 MK=1,3                                                      MOD 440
      FM=MK                                                             MOD 450
      XE(I,MK+5)=FM/3.*(FXE(I)-XE(I,5))+XE(I,5)                         MOD 460
      YE(I,MK+5)=FM/3.*(FYE(I)-YE(I,5))+YE(I,5)                         MOD 470
      ZE(I,MK+5)=FM/3.*(FZE(I)-ZE(I,5))+ZE(I,5)                         MOD 480
70    CONTINUE                                                          MOD 490
      NOC=4                                                             MOD 500
      GO TO 90                                                          MOD 510
80    XE(I,8)=FXE(I)                                                    MOD 520
      YE(I,8)=FYE(I)                                                    MOD 530
      ZE(I,8)=FZE(I)                                                    MOD 540
      XE(I,7)=XE(I,6)                                                   MOD 550
      YE(I,7)=YE(I,6)                                                   MOD 560
      ZE(I,7)=ZE(I,6)                                                   MOD 570
      XE(I,6)=0.5*(XE(I,5)+XE(I,6))                                     MOD 580
      YE(I,6)=0.5*(YE(I,5)+YE(I,6))                                     MOD 590
      ZE(I,6)=0.5*(ZE(I,5)+ZE(I,6))                                     MOD 600
      NOC=4                                                             MOD 610
90    CALL LEADLM (NOC,BXE,BYE,BZE,NIT,I)                               MOD 620
      DO 100 MJ=1,NIT                                                   MOD 630
      JJ=MJ+5                                                           MOD 640
      XE(I,JJ)=BXE(MJ)                                                  MOD 650
      YE(I,JJ)=BYE(MJ)                                                  MOD 660
      ZE(I,JJ)=BZE(MJ)                                                  MOD 670
100   CONTINUE                                                          MOD 680
      ZBZ=ZCA+(FXE(I)-XCA)*(ZCB-ZCA)/(XCB-XCA)                          MOD 690
      NCR=NCOP(I)                                                       MOD 700
      NCR1=NCR-1                                                        MOD 710
      XE(I,NCR)=FXE(I)                                                  MOD 720
      YE(I,NCR)=FYE(I)                                                  MOD 730
      ZE(I,NCR)=ZBZ                                                     MOD 740
110   CONTINUE                                                          MOD 750
      ISF=1                                                             MOD 760
      RETURN                                                            MOD 770
C                                                                       MOD 780
```

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C                                                                       MOD 790
120   FORMAT (1H1,,68H FAIL TO GET INTERSECTION BY THE WELL DEFINED FREEMOD 800
     1  VORTEX ELEMENTS )                                               MOD 810
      END                                                               MOD 820-


      SUBROUTINE CHOPS (LL,IC,I,J,XB,YB,ZB,NXB,NGB,FXE,FYE,FZE,XCA,XCB,ZCPS  10
     1CA,ZCB)                                                           CPS  20
C     FIND THE INTERSECTION BETWEEN THE LEADING EDGE VORTEX FILAMENT    CPS  30
C     AND THE CENTROID OF THE LEADING EDGE VORTEX SYSTEM                CPS  40
      DIMENSION FXE(10),FYE(10),FZE(10)                                 CPS  50
      DIMENSION XB(40,2),YB(40,2),ZB(40,2),A(3),B(3),C(3)               CPS  60
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40)                        CPS  70
      NGB=0                                                             CPS  80
C     CHECK POINT 1 AND 2 ON VORTEX FILAMENT                            CPS  90
10    CONTINUE                                                          CPS 100
      A(1)=XE(I,J+1)-XB(IC,LL)                                          CPS 110
      A(2)=YE(I,J+1)-YB(IC,LL)                                          CPS 120
      A(3)=0.                                                           CPS 130
      B(1)=XB(IC+1,LL)-XB(IC,LL)                                        CPS 140
      B(2)=YB(IC+1,LL)-YB(IC,LL)                                        CPS 150
      B(3)=0.                                                           CPS 160
      CALL CRSPRD (A,B,C)                                               CPS 170
      C1=C(3)                                                           CPS 180
      A(1)=XE(I,J)-XB(IC,LL)                                            CPS 190
      A(2)=YE(I,J)-YB(IC,LL)                                            CPS 200
      A(3)=0.                                                           CPS 210
      CALL CRSPRD (A,B,C)                                               CPS 220
      C2=C(3)                                                           CPS 230
      IF (C1*C2.GT.0.) GO TO 20                                         CPS 240
C     CHECK POINT 3 AND 4 ON CENTROID                                   CPS 250
      A(1)=XB(IC+1,LL)-XE(I,J)                                          CPS 260
      A(2)=YB(IC+1,LL)-YE(I,J)                                          CPS 270
      A(3)=0.                                                           CPS 280
      B(1)=XE(I,J+1)-XE(I,J)                                            CPS 290
      B(2)=YE(I,J+1)-YE(I,J)                                            CPS 300
      B(3)=0.                                                           CPS 310
      CALL CRSPRD (A,B,C)                                               CPS 320
      C1=C(3)                                                           CPS 330
      A(1)=XB(IC,LL)-XE(I,J)                                            CPS 340
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      A(2)=YB(IC,LL)-YF(I,J)                                            CPS 350
      A(3)=0.                                                           CPS 360
      CALL CRSPRD (A,B,C)                                               CPS 370
      C2=C(3)                                                           CPS 380
      IF (C1*C2.GT.0.) GO TO 20                                         CPS 390
      NGB=1                                                             CPS 400
      XCA=XE(I,J)                                                       CPS 410
      CALL CFSET (XCA,YCA,ZCA,IC,XB,YB,ZB,LL)                           CPS 420
      XCB=XE(I,J+1)                                                     CPS 430
      CALL CFSET (XCB,YCB,ZCB,IC,XB,YB,ZB,LL)                           CPS 440
      XYAB=(XCB-XCA)/(YCB-YCA)                                          CPS 450
      XYE=(XE(I,J+1)-XE(I,J))/(YE(I,J+1)-YE(I,J))                       CPS 460
      BB1=XCA-(XYAB*YCA)                                                CPS 470
      BB2=XE(I,J)-(XYE*YE(I,J))                                         CPS 480
      DENOM=XYAB-XYE                                                    CPS 490
      FXE(I)=(XYAB*BB2-XYE*BB1)/DENOM                                   CPS 500
      FYE(I)=(BB2-BB1)/DENOM                                            CPS 510
      FZE(I)=ZE(I,J)+(FXE(I)-XE(I,J))*(ZE(I,J+1)-ZE(I,J))/(XE(I,J+1)-XE(CPS 520
     1I,J))                                                             CPS 530
      RETURN                                                            CPS 540
20    IC=IC+1                                                           CPS 550
      IF (IC.GE.NXB) RETURN                                             CPS 560
      GO TO 10                                                          CPS 570
      END                                                               CPS 580-


      SUBROUTINE LIRITN (NCOR,NELM,M1,LASTE)                            LRN  10
      COMMON /LOC/ FU1,FU2,XEND,PXL(5),PXT(5),PYL(5)                    LRN  20
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                LRN  30
      COMMON /ALLRA/ TTL(16),ALPHA                                      LRN  40
      COMMON /ABC/ PXE(10,40),PYE(10,40),PZE(10,40)                     LRN  50
      DIMENSION M1(1),NCOR(1),NELM(1)                                   LRN  60
C                                                                       LRN  70
C     LINEAR INTERPOLATION OF LAST TWO VORTEX STRIPS                    LRN  80
C                                                                       LRN  90
      IF (ISPAN.EQ.0) IX=1                                              LRN 100
      IF (ISPAN.EQ.1) IX=2                                              LRN 110
      NSW1=MAXL                                                         LRN 120
      IF (ITRAKE.EQ.1) GO TO 50                                         LRN 130
      NN2=M1(1)+2                                                       LRN 140
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      DO 40 I=2,MAXL                                                    LRN 150
      IF (I.EQ.M1(1)) GO TO 40                                          LRN 160
      IF (I.EQ.M1(1)-2.OR.I.EQ.NN2) GO TO 40                            LRN 170
      IF (I.LE.M1(1)-1) GO TO 20                                        LRN 180
      LAXN=NN2                                                          LRN 190
      RXE=(PXE(I,5)-PXL(IX+1))/(PXE(LAXN,5)-PXL(IX+1))                  LRN 200
      RYE=PYE(I,5)/PYE(LAXN,5)                                          LRN 210
      NXOR=NCOR(I)                                                      LRN 220
      DO 10 L=6,NXOR                                                    LRN 230
      PXE(I,L)=PXL(IX+1)+(PXE(LAXN,L)-PXL(IX+1))*RXE                    LRN 240
      PYE(I,L)=PYE(LAXN,L)*RYE                                          LRN 250
      PZE(I,L)=PZE(LAXN,L)*RYE                                          LRN 260
10    CONTINUE                                                          LRN 270
      GO TO 40                                                          LRN 280
20    CONTINUE                                                          LRN 290
      N=M1(1)-2                                                         LRN 300
      RXE=(PXE(I,5)-PXL(IX))/(PXE(N,5)-PXL(IX))                         LRN 310
      RYE=PYE(I,5)/PYE(N,5)                                             LRN 320
      NXOR=NCOR(I)                                                      LRN 330
      DO 30 M=6,NXOR                                                    LRN 340
      PXE(I,M)=PXL(IX)+(PXE(N,M)-PXL(IX))*RXE                           LRN 350
      PYE(I,M)=PYE(N,M)*RYE                                             LRN 360
      PZE(I,M)=PZE(N,M)*RYE                                             LRN 370
30    CONTINUE                                                          LRN 380
40    CONTINUE                                                          LRN 390
      GO TO 150                                                         LRN 400
50    CONTINUE                                                          LRN 410
      IF (ISF.EQ.0) GO TO 60                                            LRN 420
      GO TO 80                                                          LRN 430
60    NST=NSW1/2                                                        LRN 440
      DO 70 I=LASTE,NSW1                                                LRN 450
      NXOR=NCOR(I)                                                      LRN 460
      DO 70 L=6,NXOR                                                    LRN 470
      X1=(PXE(NST,L-1)-PXL(1))**2                                       LRN 480
      Y1=(PYE(NST,L-1)-PYL(1))**2                                       LRN 490
      Z1=(PZE(NST,L-1))**2                                              LRN 500
      FL1=SQRT(X1+Y1+Z1)                                                LRN 510
      X2=(PXE(I,L-1)-PXL(1))**2                                         LRN 520
      Y2=(PYE(I,L-1)-PYL(1))**2                                         LRN 530
      Z2=(PZE(I,L-1))**2                                                LRN 540
      FL2=SQRT(X2+Y2+Z2)                                                LRN 550
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      FK=FL1/FL2                                                        LRN 560
      PXE(I,L)=PXE(I,L-1)+(PXE(NST,L)-PXE(NST,L-1))/FK                  LRN 570
      PYE(I,L)=PYE(I,L-1)+(PYE(NST,L)-PYE(NST,L-1))/FK                  LRN 580
      PZE(I,L)=PZE(I,L-1)+(PZE(NST,L)-PZE(NST,L-1))/FK                  LRN 590
70    CONTINUE                                                          LRN 600
80    CONTINUE                                                          LRN 610
      RXE=(PXE(2,5)-PXL(1))/(PXE(3,5)-PXL(1))                           LRN 620
      RYE=(PYE(2,5)-PYL(1))/(PYE(3,5)-PYL(1))                           LRN 630
      NXOB=NCOR(2)-1                                                    LRN 640
      DO 90 L=6,NXOB                                                    LRN 650
      PXE(2,L)=(PXE(3,L)-PXL(1))*RXE+PXL(1)                             LRN 660
      PYE(2,L)=(PYE(3,L)*RYE)+PYL(1)                                    LRN 670
      PZE(2,L)=PZE(3,L)*RYE                                             LRN 680
90    CONTINUE                                                          LRN 690
      NELM(NSW1)=12                                                     LRN 700
      NSW5=NSW1+NELM(NSW1)-NCOR(NSW1)-1                                 LRN 710
      NCR=NCOR(NSW1)                                                    LRN 720
      NCA=NCOR(NSW1-1)                                                  LRN 730
      DY=(PYE(NSW1,NCR)-PYE(NSW1-1,NCA))                                LRN 740
      DX=(PXE(NSW1,NCR)-PXE(NSW1-1,NCA))                                LRN 750
      DYDX=DY/DX                                                        LRN 760
      DO 100 I=NSW1,NSW5                                                LRN 770
      J=I-NSW1+1                                                        LRN 780
      JJ=J-1                                                            LRN 790
      DXX=PXE(NSW1,NCR+J)-PXE(NSW1,NCR+JJ)                              LRN 800
      PYE(NSW1,NCR+J)=PYE(NSW1,NCR+JJ)+(DYDX*DXX)                       LRN 810
      PXE(NSW1,NCR+J)=PXE(NSW1,NCR+JJ)+DX                               LRN 820
100   CONTINUE                                                          LRN 830
      DO 130 I=2,NSW5                                                   LRN 840
      IF (I.GE.NSW1) GO TO 110                                          LRN 850
      JK=NCOR(I)+1                                                      LRN 860
      NK=NCOR(I+1)                                                      LRN 870
      II=I                                                              LRN 880
      GO TO 120                                                         LRN 890
110   CONTINUE                                                          LRN 900
      II=NSW1-1                                                         LRN 910
      JK=NCOR(II)+(I-II)+1                                              LRN 920
      NK=NCOR(NSW1)+I-NSW1+1                                            LRN 930
120   IF (II.LT.2) GO TO 130                                            LRN 940
      PXE(II,JK)=PXE(II+1,NK)                                           LRN 950
      PYE(II,JK)=PYE(II+1,NK)                                           LRN 960
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      PZE(II,JK)=PZE(II+1,NK)                                           LRN 970
      II=II-1                                                           LRN 980
      NK=JK                                                             LRN 990
      JK=NCOR(II)+(I-II)+1                                              LRN1000
      GO TO 120                                                         LRN1010
130   CONTINUE                                                          LRN1020
      LL=1                                                              LRN1030
      L1=NSW1                                                           LRN1040
      L3=2                                                              LRN1050
      DO 140 I=2,NSW1                                                   LRN1060
      NELM(I)=NELM(NSW1)+(NSW1-I)                                       LRN1070
140   CONTINUE                                                          LRN1080
      GO TO 250                                                         LRN1090
150   CONTINUE                                                          LRN1100
      LL=1                                                              LRN1110
      L1=M1(1)-1                                                        LRN1120
      L2=L1-1                                                           LRN1130
      NSW6=L2                                                           LRN1140
      L3=2                                                              LRN1150
      GO TO 170                                                         LRN1160
160   LL=2                                                              LRN1170
      L1=MAXL                                                           LRN1180
      L2=L1-1                                                           LRN1190
      NSW6=L2                                                           LRN1200
      L3=M1(1)+1                                                        LRN1210
170   CONTINUE                                                          LRN1220
      NCA=NCOR(L2)                                                      LRN1230
      NCR=NCOR(L1)                                                      LRN1240
      DXX=PXE(L1,NCR)-PXE(L2,NCA)                                       LRN1250
      DYY=PYE(L1,NCR)-PYE(L2,NCA)                                       LRN1260
      DZZ=PZE(L1,NCR)-PZE(L2,NCA)                                       LRN1270
      DYDX=DYY/DXX                                                      LRN1280
      DZDX=DZZ/DXX                                                      LRN1290
      DX=(PXT(LL)-PXL(LL))/4.                                           LRN1300
      IC=1                                                              LRN1310
      PAV=0.5*(PXT(LL)+PXT(LL+1))+0.5*(PXT(LL)-PXL(LL))                 LRN1320
      PAX=PXE(L1,NCR)+DX                                                LRN1330
180   IF (PAX.GT.PAV) GO TO 190                                         LRN1340
      IC=IC+1                                                           LRN1350
      PAX=PAX+DX                                                        LRN1360
      GO TO 180                                                         LRN1370
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190   JJ=NCR+IC                                                    LRN1380
      I=L1                                                         LRN1390
      J=NCR+1                                                      LRN1400
      DO 200 K=J,JJ                                                LRN1410
      PXE(I,K)=PXE(I,K-1)+DX                                       LRN1420
      PYE(I,K)=PYE(I,K-1)+DX*DYDX                                  LRN1430
      PZE(I,K)=PZE(I,K-1)+DX*DZDX                                  LRN1440
200   CONTINUE                                                     LRN1450
      NELM(L1)=JJ                                                  LRN1460
      DO 210 I=L3,NSW6                                             LRN1470
      NELM(I)=NELM(L1)+(L1-I)                                      LRN1480
210   CONTINUE                                                     LRN1490
C     UP TO THIS STEP, THE NODE POINT OF THE CORE IS NO. 11        LRN1500
      KK=L1-1                                                      LRN1510
220   LA=NELM(KK)-NCOR(KK)                                         LRN1520
      DO 230 I=1,LA                                                LRN1530
      J=NCOR(KK)+I                                                 LRN1540
      PXE(KK,J)=PXE(KK+1,J-1)                                      LRN1550
      PYE(KK,J)=PYE(KK+1,J-1)                                      LRN1560
      PZE(KK,J)=PZE(KK+1,J-1)                                      LRN1570
230   CONTINUE                                                     LRN1580
      KK=KK-1                                                      LRN1590
      IF (KK.LT.L3) GO TO 240                                      LRN1600
      GO TO 220                                                    LRN1610
240   CONTINUE                                                     LRN1620
250   CONTINUE                                                     LRN1630
      DO 260 I=L3,L1                                               LRN1640
      NCOR(I)=NCOR(I)+1                                            LRN1650
      NELM(I)=NELM(I)+1                                            LRN1660
      M=NCOR(I)                                                    LRN1670
      K=NELM(I)                                                    LRN1680
      DO 260 J=M,K                                                 LRN1690
      JJ=K-(J-M)                                                   LRN1700
      PXE(I,JJ)=PXE(I,JJ-1)                                        LRN1710
      PYE(I,JJ)=PYE(I,JJ-1)                                        LRN1720
      PZE(I,JJ)=PZE(I,JJ-1)                                        LRN1730
260   CONTINUE                                                     LRN1740
C     THE ORDER OF THE NODE POINT ALONG THE CORE IS 12TH           LRN1750
      TT=TAN(ALPHA)                                                LRN1760
      CALL AZCORE (TT,PXL,PXT,PYL,NCOR,NELM,L1,L3,LL)              LRN1770
      IF (ITRAKE.NE.1.AND.LL.EQ.1) GO TO 160                       LRN1780
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      RETURN                                                            LRN1790
      END                                                               LRN1800-


      SUBROUTINE AZCORE (TT,PXL,PXT,PYL,NCOR,NELM,L1,L3,LL)             AZC  10
      DIMENSION PXL(1),PXT(1),PYL(1),NCOR(1),NELM(1)                    AZC  20
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40)                        AZC  30
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                AZC  40
      COMMON /CAMB/ ICAM                                                AZC  50
      IF (ITRAKE.NE.1) GO TO 20                                         AZC  60
C     SMITH&S RESULTS  ARE APPLIED ONLY TO THE ONE CORE SYSTEM          AZC  70
      PXP=PXL(LL)                                                       AZC  80
      TANG=(PYL(LL+1)-PYL(LL))/(PXT(LL)-PXL(LL))                        AZC  90
      TRT=TT/TANG                                                       AZC 100
      DO 10 I=L3,L1                                                     AZC 110
      K=NELM(I)                                                         AZC 120
      NN=NCOR(I)                                                        AZC 130
      DO 10 IK=NN,K                                                     AZC 140
      TZAE=TANG*(XE(I,IK)-PXP)                                          AZC 150
      IF (TRT.LT.1.2) ZE(I,IK)=TZAE*(0.189*TRT+0.08)                    AZC 160
      IF (TRT.GE.1.2.AND.TRT.LT.2.2) ZE(I,IK)=TZAE*(0.1333*TRT+0.158)   AZC 170
      IF (TRT.GE.2.2) ZE(I,IK)=TZAE*(0.13*TRT+0.132)                    AZC 180
10    CONTINUE                                                          AZC 190
20    CONTINUE                                                          AZC 200
      NXOR=NCOR(L3)                                                     AZC 210
      FZMIN=0.2*(XE(L3,NXOR)-PXL(LL))*TT                                AZC 220
      IF (ZE(L3,NXOR).LT.FZMIN) ZE(L3,NXOR)=FZMIN                       AZC 230
      RETURN                                                            AZC 240
      END                                                               AZC 250-


      SUBROUTINE APFXC (NELM,NCOR,M1)                                   APX  10
      DIMENSION M1(1),NCOR(1),NELM(1)                                   APX  20
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40)                        APX  30
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                APX  40
      COMMON /LOC/ FU1,FU2,XEND,PXL(5),PXT(5),PYL(5)                    APX  50
      LL=1                                                              APX  60
      IM=1                                                              APX  70
      L1=M1(1)-1                                                        APX  80
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      L3=IM                                                             APX  90
      GO TO 20                                                          APX 100
10    IM=M1(1)                                                          APX 110
      LL=2                                                              APX 120
      L1=MAXL                                                           APX 130
      L3=IM                                                             APX 140
20    CONTINUE                                                          APX 150
      NELM(IM)=NELM(IM+1)+1                                             APX 160
      NCOR(IM)=NCOR(IM+1)                                               APX 170
      K=NCOR(IM)                                                        APX 180
      DO 30 IJ=5,K                                                      APX 190
      XE(IM,IJ)=XE(IM,4)                                                APX 200
      YE(IM,IJ)=YE(IM,4)                                                APX 210
      ZE(IM,IJ)=ZE(IM,4)                                                APX 220
30    CONTINUE                                                          APX 230
      NSW8=NELM(IM)-NCOR(IM)                                            APX 240
      DO 40 I=1,NSW8                                                    APX 250
      J=NCOR(IM)+I                                                      APX 260
      XE(IM,J)=XE(IM+1,J-1)                                             APX 270
      YE(IM,J)=YE(IM+1,J-1)                                             APX 280
      ZE(IM,J)=ZE(IM+1,J-1)                                             APX 290
40    CONTINUE                                                          APX 300
      CALL AYCORE (PXL,PXT,PYL,NCOR,NELM,L1,L3,LL)                      APX 310
      IF (ITRAKE.NE.1.AND.LL.EQ.1) GO TO 10                             APX 320
      RETURN                                                            APX 330
      END                                                               APX 340-


      SUBROUTINE AYCORE (PXL,PXT,PYL,NCOR,NELM,L1,L3,LL)                AYC  10
      DIMENSION PXL(1),PXT(1),PYL(1),NELM(1),NCOR(1)                    AYC  20
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40)                        AYC  30
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC                AYC  40
      COMMON /ALLPA/ TTL(16),ALPHA                                      AYC  50
      TANG=(PYL(LL+1)-PYL(LL))/(PXL(LL+1)-PXL(LL))                      AYC  60
      PAV=0.5*(PXT(LL)+PXT(LL+1))                                       AYC  70
      DO 10 I=L3,L1                                                     AYC  80
      K=NELM(I)                                                         AYC  90
      NN=NCOR(I)                                                        AYC 100
      DO 10 IK=NN,K                                                     AYC 110
      TZAE=TANG*(XE(I,IK)-PXL(LL))                                      AYC 120
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      IF (XF(I,IK).GT.PAV) TZAF=PYL(LL+1)-PYL(LL)                       AYC 130
      FYE=0.6*TZAF                                                      AYC 140
      IF (YF(I,IK).GT.FYE.AND.XE(I,IK).LT.PAV) GO TO 10                 AYC 150
      IF (XE(I,IK).GE.PAV.AND.YF(I,IK).GT.FYE) GO TO 10                 AYC 160
      YE(I,IK)=0.62*TZAF+PYL(LL)                                        AYC 170
10    CONTINUE                                                          AYC 180
C     SET UP THE GOOD SHAPE OF THE STRAKE CORE ON THE X-Y PLANE         AYC 190
      IF (ITRAKE.EQ.1.OR.LL.NE.1) GO TO 60                              AYC 200
      KK=NCOR(L1)                                                       AYC 210
      JJ=NELM(L1)-1                                                     AYC 220
      DXX=XE(L1,KK)-XE(L1-1,KK)                                         AYC 230
      DYY=YE(L1,KK)-YE(L1-1,KK)                                         AYC 240
      DZZ=ZE(L1,KK)-ZE(L1-1,KK)                                         AYC 250
      DYDX=DYY/DXX                                                      AYC 260
      DZDX=DZZ/DXX                                                      AYC 270
      DO 20 I=KK,JJ                                                     AYC 280
      DX=XE(L1,I+1)-XE(L1,I)                                            AYC 290
      YE(L1,I+1)=YE(L1,I)+DX*DYDX                                       AYC 300
      ZE(L1,I+1)=ZE(L1,I)+DX*DZDX                                       AYC 310
20    CONTINUE                                                          AYC 320
C     REGROUP THE NODE POINTS ALONG THE CORE ON THE STRAKE SECTION      AYC 330
      KK=L1-1                                                           AYC 340
30    LA=NELM(KK)-NCOR(KK)                                              AYC 350
      DO 40 I=1,LA                                                      AYC 360
      J=NCOR(KK)+I                                                      AYC 370
      XE(KK,J)=XE(KK+1,J-1)                                             AYC 380
      YE(KK,J)=YE(KK+1,J-1)                                             AYC 390
      ZE(KK,J)=ZE(KK+1,J-1)                                             AYC 400
40    CONTINUE                                                          AYC 410
      KK=KK-1                                                           AYC 420
      IF (KK.LT.2) GO TO 50                                             AYC 430
      GO TO 30                                                          AYC 440
50    CONTINUE                                                          AYC 450
60    CONTINUE                                                          AYC 460
C     TO SET UP THE INITIAL FREE SHEET AND CORE IN STANDARD FORM        AYC 470
      IF (ITRAKE.NE.1) RETURN                                           AYC 480
      NXOR=NCOR(L3)                                                     AYC 490
      NXOR1=NXOR+1                                                      AYC 500
      NXOR2=NXOR+2                                                      AYC 510
      RY=(YE(L3,NXOR2)-PYL(LL))/(XE(L3,NXOR2)-PXL(LL))                  AYC 520
      RZ=(ZF(L3,NXOR2)-0.)/(XE(L3,NXOR2)-PXL(LL))                       AYC 530
```

```
      YE(L3,NXOR1)=RY*(XE(L3,NXOR1)-PXL(LL))+PYL(LL)                    AYC 540
      ZE(L3,NXOR1)=RZ*(XE(L3,NXOR1)-PXL(LL))                            AYC 550
      ZE(L3,NXOR1)=0.5*(ZE(L3,NXOR1)+ZE(L3,NXOR2))                      AYC 560
C     MODIFY THE FREE SHEET PORTION NEAR APEX REGION                    AYC 570
      XE(L3+1,NXOR)=XE(L3,NXOR1)                                        AYC 580
      YE(L3+1,NXOR)=YE(L3,NXOR1)                                        AYC 590
      ZE(L3+1,NXOR)=ZE(L3,NXOR1)                                        AYC 600
C     ******                                                            AYC 610
      XE(L3+1,NXOR-1)=XE(L3+1,NXOR)                                     AYC 620
      YE(L3+1,NXOR-1)=YE(L3+1,NXOR)                                     AYC 630
      ZE(L3+1,NXOR-1)=ZE(L3+1,NXOR)                                     AYC 640
C     ******                                                            AYC 650
      XE(L3+1,NXOR-2)=XE(L3+1,NXOR)                                     AYC 660
      YE(L3+1,NXOR-2)=YE(L3+1,NXOR)                                     AYC 670
      RETURN                                                            AYC 680
      END                                                               AYC 690-


      SUBROUTINE LEADLM (NOC,BXE,BYE,BZE,NIT,I)                         LAD  10
      DIMENSION PNT(20,3),FLEN(20),COEF(20,4,3),                        LAD  20
     1BXE(5),BYE(5),BZE(5),SP(20)                                       LAD  30
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40)                        LAD  40
C     LEADING-EDGE VORTEX SEGMENT STARTS FROM FIFTH POINT OF LEADING    LAD  50
C     EDGE FREE ELEMENT ON FREE SHEET                                   LAD  60
      NOC1=NOC-1                                                        LAD  70
      DO 10 J=1,NOC                                                     LAD  80
      JJ=J+4                                                            LAD  90
      PNT(J,1)=XE(I,JJ)                                                 LAD 100
      PNT(J,2)=YE(I,JJ)                                                 LAD 110
      PNT(J,3)=ZE(I,JJ)                                                 LAD 120
10    CONTINUE                                                          LAD 130
      EPS=0.                                                            LAD 140
      N=0                                                               LAD 150
      MAXN=20                                                           LAD 160
      MAXSP=20                                                          LAD 170
      IX=NOC                                                            LAD 180
      IPT=-1                                                            LAD 190
      CALL CSIPAR (MAXN,IX,PNT,N,MAXSP,EPS,K1,IPT,ELEN,COEF,CPT,IERR)   LAD 200
      SP(1)=0.                                                          LAD 210
      ST=0.                                                             LAD 220
```

```
      DO 20 K=2,NOC                                                     LAD 230
      SP(K)=SP(K-1)+ELEN(K-1)                                           LAD 240
20    ST=ST+FLEN(K-1)                                                   LAD 250
      DO 50 L=1,NIT                                                     LAD 260
      FL=L                                                              LAD 270
      DS=ST*FL/NIT                                                      LAD 280
      LL=1                                                              LAD 290
30    IF (DS.GT.SP(LL).AND.DS.LE.SP(LL+1)) GO TO 40                     LAD 300
      LL=LL+1                                                           LAD 310
      GO TO 30                                                          LAD 320
40    DT=(DS-SP(LL))/(SP(LL+1)-SP(LL))                                  LAD 330
      BXE(L)=COEF(LL,1,1)*(DT**3)+COEF(LL,2,1)*(DT**2)+COEF(LL,3,1)*DT+CLAD 340
     1OEF(LL,4,1)                                                       LAD 350
      BYE(L)=COEF(LL,1,2)*(DT**3)+COEF(LL,2,2)*(DT**2)+COEF(LL,3,2)*DT+CLAD 360
     1OEF(LL,4,2)                                                       LAD 370
      BZE(L)=COEF(LL,1,3)*(DT**3)+COEF(LL,2,3)*(DT**2)+COEF(LL,3,3)*DT+CLAD 380
     1OEF(LL,4,3)                                                       LAD 390
50    CONTINUE                                                          LAD 400
      RETURN                                                            LAD 410
      END                                                               LAD 420-


      SUBROUTINE CFSET (XX1,YY1,ZZ1,IC,XB,YB,ZB,LL)                     SET  10
      DIMENSION XB(40,2),YB(40,2),ZB(40,2)                              SET  20
      D1=XX1-XB(IC,LL)                                                  SET  30
      D2=XB(IC+1,LL)-XB(IC,LL)                                          SET  40
      D3=YB(IC+1,LL)-YB(IC,LL)                                          SET  50
      YY1=YB(IC,LL)+(D3*D1)/D2                                          SET  60
      D4=ZB(IC+1,LL)-ZB(IC,LL)                                          SET  70
      ZZ1=ZB(IC,LL)+(D4*D1)/D2                                          SET  80
      RETURN                                                            SET  90
      END                                                               SET 100-


      SUBROUTINE MINMAX (X1,X2,XMN,XMX)                                 MAX  10
      XMN=AMIN1(X1,X2)                                                  MAX  20
      XMX=AMAX1(X1,X2)                                                  MAX  30
      RETURN                                                            MAX  40
      END                                                               MAX  50-
```

```
      SUBROUTINE CENTRD (XSTN,YSTN,ZSTN,NMAX,NSW1,NELM,ISECT)
      DIMENSION YSTN(1),ZSTN(1),NELM(1)
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40)
      COMMON /GENCF/ M1(5)
      COMMON /AERO/ NAERO,MAXL,MAXW,ISPAN,ISF,ITRAKE,ISC
      I=2
      IF (ITRAKE.NE.1.AND.ISECT.EQ.2) I=M1(1)+1
      NSUB=5
      K=NSUB
10    KMAX=NELM(I)
      IF (XE(I,K).GE.XSTN) GO TO 60
20    IF (XE(I,K).LE.XSTN.AND.XE(I,K+1).GE.XSTN) GO TO 30
      K=K+1
      IF (K.EQ.KMAX) GO TO 50
      GO TO 20
30    CALL COORD (XSTN,I,K,YSTN(I),ZSTN(I))
40    I=I+1
      K=NSUB
      IF (I.GT.NSW1) GO TO 70
      GO TO 10
50    YSTN(I)=YE(I,K)
      ZSTN(I)=ZE(I,K)
      GO TO 40
60    NMAX=I-1
      RETURN
70    NMAX=NSW1
      RETURN
      END
```

```
      SUBROUTINE COORD (XS,I,K,YS,ZS)
      COMMON /ABC/ XE(10,40),YE(10,40),ZE(10,40)
      DX=XE(I,K+1)-XE(I,K)
      DY=YE(I,K+1)-YE(I,K)
      DZ=ZE(I,K+1)-ZE(I,K)
      YS=YE(I,K)+DY*(XS-XE(I,K))/DX
      ZS=ZE(I,K)+DZ*(XS-XE(I,K))/DX
```

```
      RETURN                                                            C00  80
      END                                                               C00  90-


      SUBROUTINE CSIPAR(MAXN,IX,PNT,N,MAXSP,EPS,K1,IPT,ELEN,COEF,CPT,   CSIP0010
     1                  IERR)                                           CSIP0020
C*****************************************************************CSIP0030
C*                                                                *CSIP0040
C*    PURPOSE:                                                    *CSIP0050
C*                SUBROUTINE CSIPAR COMPUTES PARAMETRIC CUBIC SPLINE  *CSIP0060
C*                COEFFICIENTS TO APPROXIMATE A SMOOTH CURVE THROUGH A *CSIP0070
C*                3D SET OF INPUT POINTS AND OPTIONALLY COMPUTES AN   *CSIP0080
C*                ENRICHED CURVE.                                     *CSIP0090
C*                                                                    *CSIP0100
C*        USE:                                                        *CSIP0110
C*                CALL CSIPAR(MAXN,IX,PNT,N,MAXSP,EPS,K1,IPT,ELEN,    *CSIP0120
C*                            COEF,CPT,IERR)                          *CSIP0130
C*                                                                    *CSIP0140
C*        MAXN    AN INPUT INTEGER SPECIFYING THE MAXIMUM NUMBER OF   *CSIP0150
C*                NODE POINTS AS GIVEN IN THE DIMENSION STATEMENT OF  *CSIP0160
C*                THE CALLING PROGRAM.                                *CSIP0170
C*                                                                    *CSIP0180
C*          IX    AN INPUT INTEGER SPECIFYING THE ACTUAL NUMBER OF    *CSIP0190
C*                NODE POINTS DEFINING THE CURVE.  IX @ MAXN.         *CSIP0200
C*                                                                    *CSIP0210
C*         PNT    A TWO-DIMENSIONAL INPUT ARRAY DIMENSIONED (MAXN,3)  *CSIP0220
C*                IN THE CALLING PROGRAM.  ON ENTRY TO CSIPAR,        *CSIP0230
C*                PNT(K,1), PNT(K,2), PNT(K,3) CONTAIN THE X,Y, AND Z *CSIP0240
C*                COORDINATES RESPECTIVELY OF THE K-TH NODE POINT TO  *CSIP0250
C*                BE FITTED.                                          *CSIP0260
C*                                                                    *CSIP0270
C*           N    AN INPUT INTEGER SPECIFYING THE NUMBER OF           *CSIP0280
C*                INTERPOLATED POINTS TO BE COMPUTED BETWEEN EACH PAIR *CSIP0290
C*                OF NODE POINTS.  IF N=0, COMPUTATION OF THE         *CSIP0300
C*                ENRICHED CURVE IS OMITTED.                          *CSIP0310
C*                                                                    *CSIP0320
C*       MAXSP    AN INPUT INTEGER SPECIFYING THE MAXIMUM NUMBER OF   *CSIP0330
C*                POINTS ALLOWED IN THE ENRICHED CURVE, AS GIVEN IN   *CSIP0340
C*                THE DIMENSION STATEMENT OF THE CALLING PROGRAM.     *CSIP0350
```

```
C*                MAXSP SHOULD BE AT LEAST (IX-1) * (N+1) + 1 TO        *CSIP0360
C*                PROVIDE FOR ALL INTERPOLATED POINTS.  IF AN ENRICHED *CSIP0370
C*                CURVE IS NOT CALCULATED, A DUMMY ARGUMENT SHOULD      *CSIP0380
C*                BE SPECIFIED FOR MAXSP.                               *CSIP0390
C*                                                                      *CSIP0400
C*          EPS   AN INPUT PARAMETER USED TO TEST CURVATURE OF THE      *CSIP0410
C*                ENRICHED CURVE.  IF THE ABSOLUTE VALUE OF THE SECOND *CSIP0420
C*                DERIVATIVE AT AN INTERPOLATED POINT IS LESS THAN      *CSIP0430
C*                EPS, THE POINT WILL BE OMITTED FROM THE ENRICHED      *CSIP0440
C*                CURVE.  IF EPS=0, ALL INTERPOLATED POINTS WILL BE     *CSIP0450
C*                RETAINED.  IF AN ENRICHED CURVE IS NOT CALCULATED,    *CSIP0460
C*                A DUMMY ARGUMENT SHOULD BE SPECIFIED FOR EPS.         *CSIP0470
C*                                                                      *CSIP0480
C*           K1   AN INPUT INTEGER SPECIFYING WHETHER A NODE POINT IS   *CSIP0490
C*                TO BE RETAINED IN THE ENRICHED CURVE WHEN THE SECOND *CSIP0500
C*                DERIVATIVE AT THE POINT IS LESS THAN EPS.             *CSIP0510
C*                   K1=1  ALL NODE POINTS WILL BE RETAINED.            *CSIP0520
C*                   K1=2  NODE POINTS WILL BE OMITTED IF SECOND        *CSIP0530
C*                         DERIVATIVE IS LESS THAN EPS.                 *CSIP0540
C*                IF AN ENRICHED CURVE IS NOT CALCULATED, A DUMMY       *CSIP0550
C*                ARGUMENT SHOULD BE SPECIFIED FOR K1.                  *CSIP0560
C*                                                                      *CSIP0570
C*          IPT   AN INPUT/OUTPUT INTEGER HAVING THE FOLLOWING          *CSIP0580
C*                FUNCTIONS:                                            *CSIP0590
C*                                                                      *CSIP0600
C*                INPUT:                                                *CSIP0610
C*                                                                      *CSIP0620
C*                =-1  WHENEVER A NEW PNT ARRAY IS SPECIFIED,IPT MUST   *CSIP0630
C*                     BE INPUT AS -1 SO THAT THE ROUTINE WILL BE       *CSIP0640
C*                     INITIALIZED.                                     *CSIP0650
C*                                                                      *CSIP0660
C*                OUTPUT:                                               *CSIP0670
C*                                                                      *CSIP0680
C*                =N   THERE ARE A TOTAL OF N POINTS IN THE             *CSIP0690
C*                     ENRICHED CURVE.                                  *CSIP0700
C*                                                                      *CSIP0710
C*         ELEN   A ONE-DIMENSIONAL OUTPUT ARRAY DIMENSIONED AT LEAST   *CSIP0720
C*                IX IN THE CALLING PROGRAM.  ON RETURN FROM CSIPAR,    *CSIP0730
C*                ELEN(K) CONTAINS THE CHORD LENGTH BETWEEN NODE        *CSIP0740
C*                POINTS K AND K+1.                                     *CSIP0750
C*                                                                      *CSIP0760
```

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C*          COEF     A THREE-DIMENSIONAL OUTPUT ARRAY DIMENSIONED          *CSIP0770
C*                   (MAXN,4,3) IN THE CALLING PROGRAM.  ON RETURN FROM    *CSIP0780
C*                   CSIPAR, COEF(K,M,N) CONTAINS THE M-TH CUBIC COEFFIC-  *CSIP0790
C*                   IENT FOR THE N-TH COORDINATE IN THE INTERVAL BETWEEN  *CSIP0800
C*                   NODE POINTS K AND K+1.                                *CSIP0810
C*                   ORDER OF CUBIC COEFFICIENTS IS:                       *CSIP0820
C*                     COEF(K,1,1)=AX   COEF(K,1,2)=AY   COEF(K,1,3)=AZ    *CSIP0830
C*                     COEF(K,2,1)=BX   COEF(K,2,2)=BY   COEF(K,2,3)=BZ    *CSIP0840
C*                     COEF(K,3,1)=CX   COEF(K,3,2)=CY   COEF(K,3,3)=CZ    *CSIP0850
C*                     COEF(K,4,1)=DX   COEF(K,4,2)=DY   COEF(K,4,3)=DZ    *CSIP0860
C*                   WHERE:                                                *CSIP0870
C*                     FX = AX*T**3 + BX*T**2 + CX*T + DX                  *CSIP0880
C*                     FY = AY*T**3 + BY*T**2 + CY*T + DY                  *CSIP0890
C*                     FZ = AZ*T**3 + BZ*T**2 + CZ*T + DZ                  *CSIP0900
C*                   AND:                                                  *CSIP0910
C*                      T = CHORDAL DISTANCE PARAMETER.                    *CSIP0920
C*                                                                         *CSIP0930
C*           CPT     A TWO-DIMENSIONAL OUTPUT ARRAY DIMENSIONED (MAXSP,3)  *CSIP0940
C*                   IN THE CALLING PROGRAM.  ON RETURN FROM CSIPAR,       *CSIP0950
C*                   CPT(K,1), CPT(K,2), CPT(K,3) CONTAIN THE X,Y,Z        *CSIP0960
C*                   COORDINATES RESPECTIVELY OF THE K-TH POINT ON THE     *CSIP0970
C*                   ENRICHED CURVE.  IF AN ENRICHED CURVE IS NOT          *CSIP0980
C*                   CALCULATED, A DUMMY ARGUMENT SHOULD BE SPECIFIED      *CSIP0990
C*                   FOR CPT.                                              *CSIP1000
C*                                                                         *CSIP1010
C*          IERR     AN OUTPUT INTEGER ERROR CODE.                         *CSIP1020
C*                   =0   NORMAL RETURN NO ERROR IN CALCULATION            *CSIP1030
C*                   =-1  INCOMPLETE FAIRED  CURVE                         *CSIP1040
C*                   =-2  LESS THAN FOUR NODE POINTS WERE SPECIFIED.       *CSIP1050
C*                        ROUTINE TERMINATES.                              *CSIP1060
C*                                                                         *CSIP1070
C*                                                                         *CSIP1080
C*                                                                         *CSIP1090
C*     REQUIRED ROUTINES                NONE                               *CSIP1100
C*                                                                         *CSIP1110
C*     SOURCE                           SUBROUTINE SPFIT WRITTEN BY        *CSIP1120
C*                                      CMPB, MODIFIED BY COMPUTER         *CSIP1130
C*                                      SCIENCES CORPORATION               *CSIP1140
C*                                                                         *CSIP1150
C*     LANGUAGE                         FORTRAN                            *CSIP1160
C*                                                                         *CSIP1170
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C*     DATE RELEASED                        OCTOBER 3, 1973                    *CSIP1180
C*                                                                             *CSIP1190
C*     LATEST REVISION                      OCTOBER 3, 1973                    *CSIP1200
C*                                                                             *CSIP1210
C*                                                                             *CSIP1220
C*****************************************************************************CSIP1230
      DIMENSION PNT(MAXN,3),ELEN(1),COEF(MAXN,4,3),CPT(MAXSP,3)                CSIP1240
      DIST(X1,Y1,Z1,X2,Y2,Z2)=SQRT((X2-X1)**2+(Y2-Y1)**2+(Z2-Z1)**2)           CSIP1250
      IF (IPT  .NE. -1) GO TO 92                                               CSIP1260
      IF(IX .LT. 4) GO TO 140                                                  CSIP1270
      IERR = 0                                                                 CSIP1280
      N1=IX-1                                                                  CSIP1290
C                                                                              CSIP1300
C          COMPUTES CHORD LENGTHS                                              CSIP1310
C                                                                              CSIP1320
      DO 30 NN=2,IX                                                            CSIP1330
         ELEN(NN-1)=DIST(PNT(NN-1,1),PNT(NN-1,2),PNT(NN-1,3),                  CSIP1340
     1   PNT(NN,1),PNT(NN,2),PNT(NN,3))                                        CSIP1350
30       CONTINUE                                                              CSIP1360
C                                                                              CSIP1370
C          SETUP COEFFICIENT MATRIX WITH UNCLAMPED END POINTS                  CSIP1380
C          SETS 2ND DER=0. AT P1 AND PN                                        CSIP1390
C                                                                              CSIP1400
      COEF(1,1,1)=0.                                                           CSIP1410
      COEF(1,1,2)=2.                                                           CSIP1420
      COEF(1,1,3)=1.                                                           CSIP1430
      COEF (IX,1,1)=1.                                                         CSIP1440
      COEF (IX,1,2)=2.                                                         CSIP1450
      COEF (IX,1,3)=0.                                                         CSIP1460
      DO 40 NN=2,N1                                                            CSIP1470
         COEF(NN,1,1)=ELEN(NN)                                                 CSIP1480
         COEF(NN,1,2)=2.*(ELEN(NN-1)+ELEN(NN))                                 CSIP1490
         COEF(NN,1,3)=ELEN(NN-1)                                               CSIP1500
40       CONTINUE                                                              CSIP1510
C                                                                              CSIP1520
C          SOLVE FOR SLOPES                                                    CSIP1530
C                                                                              CSIP1540
      DO 70 I=1,3                                                              CSIP1550
         COEF(1,4,1)=(3./ELEN(1))*(PNT(2,I)-PNT(1,I))                          CSIP1560
         COEF (IX,4,1)=(3./ELEN (IX-1))*(PNT(IX,I)-PNT(IX-1,I))                CSIP1570
         DO 60 NN=2,N1                                                         CSIP1580
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      COEF(NN,4,1)=(3./(ELEN(NN-1)*ELEN(NN)))*                          CSIP1590
     1 (ELEN(NN-1)**2*(PNT(NN+1,I)-PNT(NN,I))+                          CSIP1600
     2 ELEN(NN)**2*(PNT(NN,I)-PNT(NN-1 ,I)))                            CSIP1610
60    CONTINUE                                                          CSIP1620
C                                                                       CSIP1630
C       SOLVE TRIDIAGONAL MATRIX                                        CSIP1640
C                                                                       CSIP1650
      COEF(1,2,1)=COEF(1,1,3)/COEF(1,1,2)                               CSIP1660
      COEF(1,3,I)=COEF(1,4,1)/COEF(1,1,2)                               CSIP1670
      DO 63 K=2,IX                                                      CSIP1680
      KM1=K-1                                                           CSIP1690
      TEMP=COEF(K,1,2)-COEF(K,1,1)*COEF(KM1,2,1)                        CSIP1700
      COEF(K,2,1)= COEF(K,1,3)/TEMP                                     CSIP1710
      COEF(K,3,I)=(COEF(K,4,1)-COEF(K,1,1)*COEF(KM1,3,I))/TEMP          CSIP1720
63    CONTINUE                                                          CSIP1730
      DO 67 K=1,N1                                                      CSIP1740
      KK=IX-K                                                           CSIP1750
      COEF(KK,3,I)=COEF(KK,3,I)-COEF(KK,2,1)*COEF(KK+1,3,I)             CSIP1760
67    CONTINUE                                                          CSIP1770
70    CONTINUE                                                          CSIP1780
C                                                                       CSIP1790
C       COMPUTE CUBIC COEFFICIENTS FOR EACH SEGMENT                     CSIP1800
C                                                                       CSIP1810
      DO 90 NN=1,N1                                                     CSIP1820
      EL=1./ELEN(NN)                                                    CSIP1830
      EL2=EL*EL                                                         CSIP1840
      EL3=EL*EL2                                                        CSIP1850
      DO 90 I=1,3                                                       CSIP1860
      COEF(NN,4,I)=PNT(NN,I)                                            CSIP1870
      F=PNT(NN+1,I)-PNT(NN,I)                                           CSIP1880
      COEF(NN,2,I)=                                                     CSIP1890
     1 F*EL2*3.-                                                        CSIP1900
     2 EL*(2.*COEF(NN,3,I)+COEF(NN+1,3,I))                              CSIP1910
      COEF(NN,1,I)=                                                     CSIP1920
     1 -F*EL3*2.+                                                       CSIP1930
     2 EL2*(COEF(NN,3,I)+COEF(NN+1,3,I))                                CSIP1940
C                                                                       CSIP1950
C       REFERENCE LENGTH TO 1.                                          CSIP1960
C                                                                       CSIP1970
      COEF(NN,1,I)=COEF(NN,1,I)/EL3                                     CSIP1980
      COEF(NN,2,I)=COEF(NN,2,I)/EL2                                     CSIP1990
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            COEF(NN,3,I)=COEF(NN,3,I)/EL                                CSIP2000
90          CONTINUE                                                    CSIP2010
   92 IPT = 0                                                           CSIP2020
      IF (N .EQ. 0) RETURN                                              CSIP2030
      IF(K1 .EQ. 0 ) K1 =1                                              CSIP2040
C                                                                       CSIP2050
C           COMPUTE ENRICHED POINTS                                     CSIP2060
C                                                                       CSIP2070
      IFIT = N+1                                                        CSIP2080
      XFIT=IFIT                                                         CSIP2090
      DELT=1./XFIT                                                      CSIP2100
      DO 120 NN=1,N1                                                    CSIP2110
         DO 110 NF=1,IFIT                                               CSIP2120
            F=NF-1                                                      CSIP2130
            T=DELT*F                                                    CSIP2140
            IF(NN.EQ.1.AND.NF.EQ.1)GO TO 95                             CSIP2150
            IF(NF.EQ. 1.AND. K1 .EQ. 1 ) GO TO 95                       CSIP2160
            T6=6.*T                                                     CSIP2170
            EX=ABS(T6*COEF(NN,1,1)+2.*COEF(NN,2,1))                     CSIP2180
            EY=ABS(T6*COEF(NN,1,2)+2.*COEF(NN,2,2))                     CSIP2190
            EZ=ABS(T6*COEF(NN,1,3)+2.*COEF(NN,2,3))                     CSIP2200
            EE=(EX+EY+EZ)/(ELEN(NN)*ELEN(NN))                           CSIP2210
            IF(EE.LT.EPS)GO TO 110                                      CSIP2220
95          IF(IPT .GE. MAXSP ) GO TO 130                               CSIP2230
            IPT=IPT+1                                                   CSIP2240
            DO 100 I=1,3                                                CSIP2250
100            CPT(IPT,I)=((T*COEF(NN,1,I) + COEF(NN,2,I))*T+ COEF(NN,3,CSIP2260
     1         I))*T+COEF(NN,4,I)                                       CSIP2270
110         CONTINUE                                                    CSIP2280
120      CONTINUE                                                       CSIP2290
      IF ( IPT .GE. MAXSP ) GO TO 130                                   CSIP2300
      IPT=IPT+1                                                         CSIP2310
      DO 125 I=1,3                                                      CSIP2320
125      CPT (IPT,I)=PNT(IX,I)                                          CSIP2330
      RETURN                                                            CSIP2340
130   IERR=-1                                                           CSIP2350
      RETURN                                                            CSIP2360
140   IERR =-2                                                          CSIP2370
      RETURN                                                            CSIP2380
      END                                                               CSIP2390
```

*** RUN STREAM ***

```
LEVSP,T1777,CM177000.
USER,XXXXXX.
CHARGE,YYYYYY,LRC.
FTN.
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** COMPUTER PROGRAM **

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** DATA CARDS **

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16. Abstract

A computer code based on an improved vortex filament - vortex core method for predicting aerodynamic characteristics of slender wings with edge vortex separations has been developed. The code is applicable to camber wings, straked wings or wings with leading-edge vortex flaps at subsonic speeds. The prediction of lifting pressure distribution and the computer time have been improved by using a pair of concentrated vortex cores above the wing surface. The main features of this computer program are: (1) arbitrary camber shape may be defined and option for exactly defining leading-edge flap geometry is also provided; (2) the side-edge vortex system is incorporated.

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